AFRL-IF-RS-TR-2005-237
Final Technical Report
June 2005

INCORPORATING EFFECTS-BASED OPERATIONS INTO MILITARY OPERATIONS

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STINFO FINAL REPORT

This report has been reviewed by the Air Force Research Laboratory, Information Directorate, Public Affairs Office (IFOIPA) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be releasable to the general public, including foreign nations.

AFRL-IF-RS-TR-2005-237 has been reviewed and is approved for publication

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	JUNE 2005	Final Feb 02 – Feb 05

4. TITLE AND SUBTITLE
INCORPORATING EFFECTS-BASED OPERATIONS INTO MILITARY OPERATIONS

5. FUNDING NUMBERS
C - F30602-02-C-0007
PE - 27410F
PR - EBO0
TA - 00
WU - 10

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8. PERFORMING ORGANIZATION REPORT NUMBER
1

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Rome New York 13441-4505

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
AFRL-IF-RS-TR-2005-237

11. SUPPLEMENTARY NOTES

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12a. DISTRIBUTION / AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 Words)***

This report summarizes the activities accomplished by DMM Ventures Inc. under the Air Force Research lab Effects-based Operations Advanced Technology Demonstration (EB) ATD). The effort focused on researching and analyzing improved operational concepts, processes and techniques for an effects-based approach to conducting military operations. The contractor developed in EBO concept of operations, and experimentation scenario (Operation Deny Force) that included data and plan elements, and various supporting materials dealing with Information Operations and coalition operations as they relate to EBO.

14. SUBJECT TERMS
Effects-Based Operations, Effects, Effects Theory

15. NUMBER OF PAGES
75

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

Table of Contents

List of Figures

Introduction

Purpose/Method. This Technical Report (TR) summaries the work done by DMM Ventures Inc., and its Principal Investigator (PI) Dr Maris "Buster" McCrabb, for the Effects-based Operations Advanced Technology Demonstration (EBO ATD) from February 2002 until February 2005.

This TR proceeds as follows. It is broken down into the four tasks assigned to DMM Ventures Inc in the Statement of Work (SOW). The Introduction section concludes with some key findings from that research and some suggested areas for future research. The Appendices includes some of the original source documents written by our PI. Each is described in more detail in the SOW section to which it pertains.

Relationship to CAOC. The primary target for the EBO ATD and our work in particular was the Combined Air & Space Operations Center (CAOC). During the time of this effort, the CAOC became designated as a weapon system and the initial steps towards integrating the various piece parts that went into making a CAOC happened. A challenge for any AFRL project is projecting requirements to some future state as that state constantly changes. The early days of the CAOC Weapon System are a case in point. However, what was noteworthy is how well the concepts and technologies developed under the EBO ATD matches the current (as of March 2005) statement of requirements. This is because the ATD played a major role in shaping those requirements. The ATD, then, was a case study in "technology pull/technology push" where CAOC requirements helped shape the ATD and the ATD-discovered technologies and processes helped shape CAOC requirements. The following statements from the 15 Oct 04 (Draft) CAOC Capability Development Document (CDD) capture some of the high level requirements addressed by the EBO ATD:

♦ The CAOC requires the capability to automate integrated Air and Space effects-based dynamic strategy development and assessment processes; rapidly assess targeting effects and aggregate against COAs to continuously validate and adjust strategy.

♦ The CAOC WS requires the machine-assisted capability to execute and link the Joint Air Estimate Process (JAEP) and Joint Air Operations Plan (JAOP) development and integrate operations assessment results across CAOC WS divisions, processes, and products.

♦ The CAOC WS requires machine-assisted development of the JAOP.

Summary. The following are the 10 major findings our PI gleaned from this project.

EBO CONOPS

♦ By far the most important finding was that effects-based approaches to planning, executing, and assessing campaigns and major operations are very hard. To realize the Air Force's vision to inculcate EBO will require dedicated education, training, and readiness (ETR) efforts for the commanders and their staffs assigned to operational-level command centers like and CAOC.

♦ Because EBO is very hard, technology can be a force multiplier. Technical means can embed processes, models, and access data required to assist humans in their planning, executing, and assessing activities. These technologies must take advantage of the advances in cognitive science, workflow management and knowledge base capabilities. Some of this was done in the ATD; much remains.

♦ Besides the ETR and technical challenges, the significant challenge to realizing the Air Force's EBO vision is the challenge of overselling what EBO is and what benefits (and costs) it offers. EBO is first and foremost—as the informal motto of the ATD rightly claimed—an approach; a way of thinking. Indeed some suggest EBO is another term for "thinking strategically" and in many ways it is. The benefits from an effects-based approach are in lives and treasure saved because the ramifications of actions are better understood as they percolate through an enemy-as-a-system. The cost is increased information requirements along with the people steeped in "effects thinking".

Information Operations (IO)

♦ EBO is an approach that spans all levels of conflict, all types of operations, and is generally agnostic to the instigator of actions. Therefore, it applies equally well to IO utilizing non-lethal force as well as conventional, lethal, force-on-force operations. This is a huge finding. It means the ETR projects can build from a common base (how to do "effects thinking") then branch out into specialized applications such as "how to do PSYOPS" or "how to plan interdiction operations".

♦ Since the EBO processes are common across the various instruments of national power, interoperability is simpler to attain. This is particularly true in the technical means for planning military operations at the operational-level command centers. Indeed as the ATD progressed, two applications—one from the ATD focused mainly on conventional operations and one already being fielded focused mainly on IO—became increasingly joined.

Coalition

♦ Just as EBO spans the various ways and multitude of contexts in which military force can be applied, it equally applies to the various nations engaged jointly in military operations. As the ATD progressed, time demands dictated this task engage less and less of our PI's research time. This was regrettable but understandable. However, much was accomplished, particularly in the workup to JEFX04 which engaged much of the second half of this project. JEFX04 made Coalition Operations a centerpiece. The finding was clear: EBO translates across national boundaries.

♦ Despite the clarity with which EBO translates, Coalition operations do bring some significant challenges which were confirmed in this research. The two major ones were security concerns and the challenge of developing shared awareness. The former is largely a policy question. The latter can be somewhat addressed through technology. Again time did not allow a full examination of this but the rapid development of an ontology-based knowledge base can go a long way towards a "universal translator" needed to develop shared awareness.

Experimentation.

♦ The *raison d'être* for AFRL is experimentation. Our PI's tasks mainly consisted of developing the scenarios and plans for the various technologies to use to carry out their experiments. The major finding here reinforces what has already been said: EBO is a viable set of processes but those processes are hard to implement until the people involved become more capable of "effects thinking."

♦ The major experimentation task was known as "cross-thrust" and its purpose was to integrate AFRL projects in an operational setting. Unfortunately funding shortfalls and other concerns limited the number of these. The ones that did take place, in various forms of integration, did show the complementary nature of several technologies. An important finding was that to realize EBO is not to develop a single technology. It requires many capabilities, such as information retrieval and analysis, wargaming, and visualization, but those need to be integrated and interoperable at the information level to be useful in a military environment.

♦ JEFX04 was somewhat of a graduation exercise for the ATD. The major finding here is that the ATD needed to engage at the ultimate end-user level more than it did. There is a fine balance here. Operational units are focused, rightly, on today's environment whereas the ATD was focused on delivering technologies that can be applied in future environments. One could not go to a user and ask "how are effects-based plans built today?" and expect a meaningful answer: today's users do not build effects-based plans and have no procedures for doing so.

SOW Task 1: EBO Concepts and Categories

The contractor shall research and analyze existing operational concepts to identify improved process and technology incorporation into an effects based approach, including but not limited to the following operational areas: existing CAOC tools/structure/operations/processes, strategy development, campaign assessment, wargaming, ISR assistance/management.

Effects-based Operations (EBO) consists of planning, executing, and assessing operations in terms of achieving effects that accomplish objectives. The first task focused mainly on developing this concept. While focused mainly on effects-based planning (EBP), this summary will also address effects-based execution (EXE) and effects-based assessment (EBA) as those concepts were developed as part of our PI's task.

<u>Effects-based Planning (EBP)</u>

EBP is an operational planning process that focuses on results, not inputs. Effects-based planning examines, in detail and over time, the direct and indirect effects of proposed courses of action and determines the best available kinetic or non-kinetic means to achieve the desired effects. EBP provide joint and coalition force commanders the potential to conduct military operations more rapidly, with fewer resources, reduced collateral damage, and less casualties. This comes from an ability to see more fully the impacts of military operations, either kinetic or non-kinetic. This allows for fewer resources applied to obtain the outcome—or effect—desired. EBP is not a panacea;

however, and substantial changes in education and training, development and improvement of assessment methods, and new knowledge management tools are required to improve commanders' ability to understand and direct operations. Much remains to be done to achieve this goal.

An effects-based approach determines which actions should be taken against enemy systems to create specific effects that contribute directly to a desired military and political outcome. "Effects-Based" connotes action to produce a distinctive and desired effect. EBP subsumes, rather than replaces, objectives-based methods, which connected clearly stated objectives to proposed actions through a process of logic and historical analysis and refined them to operational plans through the strategy-to-task approach. Past actions must be compared in the context of current strategy and operations to determine applicability and relevance. A much greater understanding of enemy intent, strategy, doctrine, and capability is essential in formulating US strategy suitable to an effects-based approach. EBP requires a close and continuous interaction with effects-based intelligence.

Figure 1[1] depicts the objective-based methodology in which a higher echelon defines the objective and a lower echelon determines the tasks to achieve the objective. In the diagram, the higher echelon defines "O" or objectives from which lower echelons develop their supporting strategy. A distinction between objectives and effects can be articulated in the following terms: objectives are "achieved" or "accomplished," while effects are "produced" or "created."

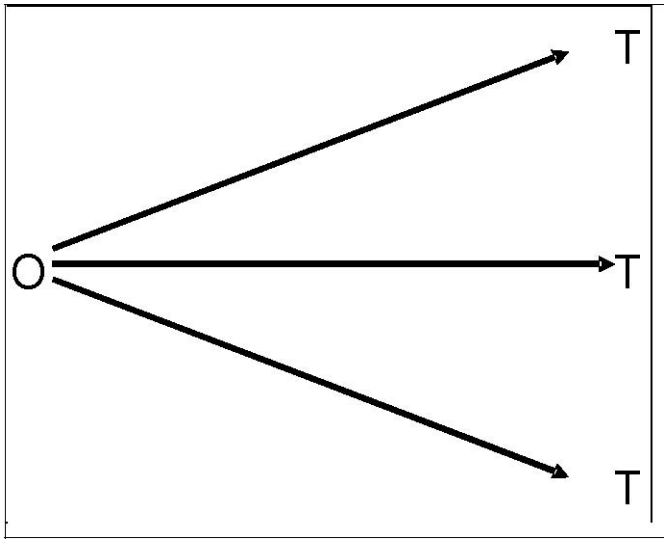

Figure 1. Objective Based Methodology.

Practically, EBP inserts an intervening step between the objective and task. See Figure 2. EBP is as much a thought process as it is a planning process. It is thinking strategically

1 Figures 1 and 2 come from the Air Combat Command (ACC) White Paper on EBO, May 2002.

with an outlook towards effects, or desired outcomes, and away from inputs. The planner or strategist asks the question, "What are the desired effects that achieve the objective?" From that question, the tasks are determined. During the task assignment, follow-up questions must be asked. "What are the undesired effects that may result from the tasks performed?" "Do I have to assign another task or objective to mitigate undesired effects?" Further, EBP requires examination of the causal linkages that justify the objective-to task-to-action-to-effect chain. Figure 2 depicts the intervening steps in the planning sequence. Planning begins with the desired objective and leads planners to determine the appropriate tasks (or actions). Planning should also include the linkages between the effects needed to achieve the objectives and the assigned tasks, as well as possible *unintended effects* resulting from the task and how that could affect the objective.

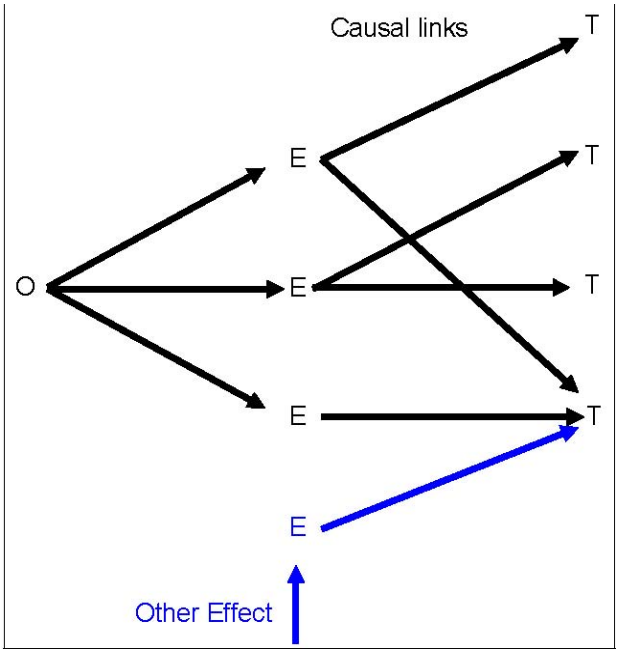

Figure 2. Effects-Based Operations Objective with Multiple Effects and Multiple Tasks.

As shown, an effect can be caused by multiple tasks. Some tasks may dominate the linkage, while others will be contributing, but peripheral. The advantages of examining causal linkages are evident when one considers the contribution of the task to effect, its probability, and its likelihood of causing ancillary effects. In this way, an effect can be achieved by specific selection of some tasks and specific exclusion of others.

Effects-based planning (EBP) allows better integration of all elements of national power. It stresses:

• Linking actions (diplomatic, information, military and economic) to operational and strategic outcome

• Planning, analyzing, and assessing implications of actions and operations in terms of effects on the adversary

• Analyzing desired and undesired effects

• Understanding the implications and consequences of effects over time (cumulative)

• Adapting plans and actions continuously to the reality of the contingency or conflict

A major product from our PI's work was development of an effects-based approach, at the detailed procedures level, to the Joint Air Estimate Process (JAEP). Another was the EBO CONOPS (Concept of Operations). The CONOPS covered effects-based execution, planning, and assessment though not to the same degree, reflecting the planning focus of the ATD. All these works derived mainly from the seminal paper "Explaining Effects" written by our PI. A synopsis of that paper is at Appendix A. The following sections summarizes the key elements of effects-based execution (EBE) and effects-based assessment (EBA) developed by our PI during the EBO ATD.

Effects-based Execution (EBE)

The main focus on the ATD ever increasingly turned to EBP. Yet, in the early days our PI developed a vision for a "Dynamic Tasking Process" enabled by a "Dynamic Tasking Toolkit."(DTT) See Figure 3. The main idea was to extend the effects-based approach from planning through execution and assessment. The core idea of the DTT was to increase the responsiveness of the command and control (C2) apparatus to the speed of command. The means to accomplish this was to make as continuous and seamless the connection between Commander's Intent and the execution orders issued from the CAOC (traditionally in an air tasking order or ATO) to the executing force elements, e.g., wings/squadrons, carrier air wings and the like.

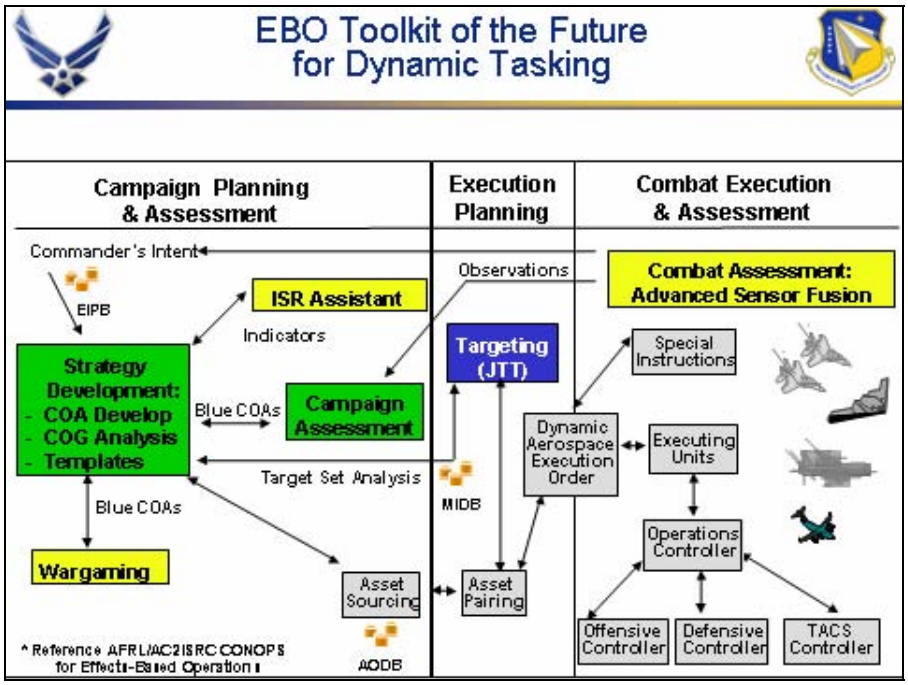

Figure 3. Dynamic Tasking Toolkit.

A major product of this work, besides the DTT concept drawings, was a paper our PI wrote on Dynamic Tasking and, more importantly, an architecture effort done that could enable a dynamic approach to effects-based execution. The next three paragraphs summarize the main ideas of the paper.

A persistent complaint about the Joint Air Tasking Order process is it is too slow and unresponsive. Unfortunately, most efforts to answer this complaint focus on the 'same process, only faster'. This does not adequately address the problem nor take advantage of available technology. The use of templates, wizards, and case-based reasoning using meta-information provided through an ontology base[2] connected to a natural language reasoner, can increase the responsiveness of planning, executing, and assessing activities for air and space operations through use of partial information and recursive reasoning.[3] The 1996 USAF Scientific Advisory Board (SAB) report proposed changes to allow operations in a nonlinear, asynchronous, and interactive manner.[4]

The characteristics of such a planning, execution and assessment system include:

- ♦ real-time, interactive, collaborative planning tools to evaluate and update COA (course-of-action) that include nonlinear, reentrant, and asynchronous planning cycles, (i.e., continuous);
- ♦ faster-than-real-time mission planning;
- ♦ rapid rehearsal using modeling and simulation;
- ♦ near real-time updates of mission/weapon profiles and BDA (battle damage assessment);
- ♦ dynamically generated tasking orders; and
- ♦ universal access to required information in the global database.

A key concept in the SAB report is that “as the target queue is dynamically built, it is also dynamically executed.” Note that “dynamic” does not mean “instantaneous.” Missions that might be executed hours, days or even weeks in advance--for example, redeployment missions—can be “planned” and entered in the queue as the requirement is generated.

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2 Ontology is a machine readable, formal language that specifies the semantics and syntax of objects—such as words—and their attributes. A very important attribute of an object is its relationship to other objects. When the objects and rules are electronically stored as data, the data base is then becomes an ontology base or, more commonly, a knowledge base.

3 Information consists of data within a specified context; meta-information is information about information.

4 USAF Scientific Advisory Board “Report on Vision of Aerospace C2 for the 21st century,” SAB TR 96-02, October 1996.

The mission does not have to be "posted" with all the detail ultimately required. Finally, the SAB report emphasizes the collaborative nature of this process between the tasking organization (CAOC) and the executing organization (the tactical unit). The DTT described briefly above arose from this 1996 report.

Effects-based Assessment (EBA)

Key to taking an effects-based approach to conflict is an ability to assess the outcomes—or effects—of actions taken to achieve those effects. Historically, assessment activities focused on the actions themselves and, at best, on progress towards achieving specific objectives, normally tactical objectives at component levels and operational and campaign (or theater) objectives at the Joint Task Force or Combatant Command level. According to the ACC White Paper on Effects-Based Assessment, effects-based operations require an effects-based assessment process to answer the commanders' question, "How is the war going?"[5] Concurrently, this effects-based process will naturally drive the subsequent step of providing the commander a "recommendation" for future operations. Building towards this, a tactical, performance-based analysis and assessment process should feed the operational level assessment. The tactical level assessment links closely to battlespace actions and focuses on capturing empirical details. Some details are rearward looking, others predictive, but in either case, they will aggregate into operational level assessments, at both the component and theater levels. Ultimately, theater assessments are used to compile strategic-level assessments. Readers should note that assessment is not confined to a single organization or organizational level. It is an inherently Joint process. A benefit from an effects-based approach is that the basic methods apply at all levels of conflict or organizational level. *Effects-based Assessment* (EBA) is the set of activities that determine the results (outcomes or effects), and the effectiveness of those results, from the execution of operations beyond the immediate results of those operations.

Assessment is crucial to successful Information Operations (IO). As well stated in AFDD 2-5, *Information Operations* (emphasis added):

> IO presents additional challenges in effects-based planning as there are many variables. Many of these variables also have human dimensions that are difficult to measure, may not be directly observable, and may also be difficult to acquire feedback. At all times, objectives must be set and effects must be analyzed from the point of view of the culture where operations are being conducted. Assessment is inherently more challenging and is predisposed to a lesser degree of accuracy than conventional battle damage assessment (BDA). Nevertheless, the planning of IO should be focused on operational objectives and the effects produced. Critical to the effects-based approach is the requirement to be able to measure, to the greatest extent possible, IO effects.[6]

EBA builds on two Combat Assessment (CA) principles: BDA reports that examine the

5 Headquarters Air Combat Command (ACC), March 2004.
6 Air Force Doctrine Center, September 2004, 28.

effects on an adversary across multiple levels and the use of measures to ascertain progress towards attaining the Commander's desired effects. Fundamentally EBA adds a third principle, one that deals with explaining the linkage between actions and effects. Furthermore, besides classic MOE (measure-of-effectiveness) and MOP (measure-of-performance) information, EBA specifies beforehand the evidence of actions, causal linkages, and outcomes (or effects). These pre-determined bits of information are collectively referred to as 'Indicators'. The basic EBA process is by marrying the Indicators, MOE and MOP—that is, the evidence, measures and criteria—with the BDA reports that provide the impact on the adversary from the target through the target system level, a more complete picture of the impact of military actions on the adversary is provided.

SOW Task 2: IO

The contractor shall research and identify how non-conventional, emerging operational concepts such as information operations, predictive battlespace awareness and the notions of employment and execution can support an effects-based operations approach. Upon Government approval, augment the existing EBO CONOPS to incorporate these concepts.

This task involved examining how EBO relates to other emerging concepts. Two in particular were Predictive Battlespace Awareness (PBA) and Network-centric Warfare (NCW). Due to funding constraints, this task halted halfway through the project. Little was done on PBA beyond refining the Warden-Barlow-McCrabb model of target systems analysis begun before this contract was awarded; however Dr McCrabb was able to delve somewhat into NCW as it related to EBO. This work is summarized below.

Network-centric Warfare (NCW)

NCW is defined as an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision-makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization.[7] Speed of command is defined as the time it takes to recognize and understand a situation (or a change in the situation), identify and assess options, select an appropriate course of action, and translate it into actionable orders. Increasing the speed of command preempts adversary options, creates new options, and improves the effectiveness of selected options. A key capability to achieve NCW promises is the self-synchronization.

The key elements of self-synchronization are two or more robustly networked entities, shared awareness, a rule set, and a value-adding interaction. The combination of a rule set and shared awareness enables the entities to operate in the absence of traditional hierarchical mechanisms for command & control (C2). The rule set describes the desired outcome in various operational situations. Shared awareness provides a mechanism for

7 Much of this research draws from *Network Centric Warfare*, 2nd edition, by David S. Alberts, John J. Garstka, and Frederick P. Stein, Washington, DC: DOD C4ISR Cooperative Research Program, August 1999.

communicating the ongoing dynamics of the operational situation and triggering the desired value-added interaction. The desired effect from NCW, achieved through self-synchronization, is information superiority.

Information superiority is a state achieved when competitive advantage derives from the ability to exploit a superior information position. It comes from shared awareness and self-synchronization. The idea is that shared understanding of the situation and commander's intent leads to self-synchronization because each actor knows what role they can play, and the shared understanding shows them what roles must be played to achieve commander's intent. Shared means that each actor's understanding is the same as each other actors at least to the extent required to achieve commander's intent. These actors reside in a Network-centric Enterprise. Finally, one result from information superiority is strategic lockout. Strategic lockout refers to the situation that exists when an adversary's strategic objectives have been locked out because he has no remaining viable courses of action. This occurs when the shock and awe resulting from the increased speed of command relative to the adversary dislocates and confuses an enemy to the point that his warfighting structures quickly disintegrate and his feasible courses of action are rapidly reduced.

The Network-centric Enterprise has an information-based strategy for creating and exploiting information superiority. It is enabled by the info structure that enables the processes of sensor netting, data fusion, and information management that, in turn, enables vastly improved awareness and shared. Those, in turn, can be exploited through the processes of virtual collaboration, virtual organizations, substituting information for people or materials, and self-synchronization. These processes produce increased tempo, increased responsiveness, lower risks, lower costs, and higher profits (i.e., effectiveness). Fusion means fusing real-time information with historical and environmental (or contextual) information. A virtual organization brings people, resources, and process together to accomplish a specific task then disband. However, NCW is not a panacea.

NCW must be grounded in operational art. It is more about networking than networks. One cannot simply add new technologies to current platforms, organizations, or doctrine. There must be a co-evolution of each DOTMLPF (doctrine, organization, training, material, leadership, personnel, and facilities) element. This has been born out from the study of multiple domains from business to warfare.

Elements of Operational NCW

♦ A Mission Capability Package (MCP) for information infrastructure, or info structure, requires CONOPS, C2 approaches, organizational forms, doctrine, force structure, support structures, and the like—all working together, for example by integrating sensing and transaction capabilities. Transaction timelines are dominated by access timelines.

♦ While predicting human and organizational behavioral will remain well beyond the state of the art, having a better near-real time picture of what is happening (in situations where this is possible from observing things that move, emit, etc.) certainly reduces uncertainty in a meaningful way. Near-real time sharing of information, for

example through a common operational picture, facilitates self-synchronization as well as increases the tempo and responsiveness of operations.

♦ The value chain describes the links or processes that transform inputs and/or raw materials into value in the form of products. Understanding its constituent parts is a necessary but not sufficient condition for improvement. Competitive advantage comes from increasing the relative value of products vis-à-vis a competitor.

Nodal Analysis

Metcalfe's Law states that while the number of nodes in a network increases linearly, the *potential* value (or effectiveness) of the network increases exponentially as the square of the number of nodes in the network. This comes from the interactions between the nodes. The potential gains can become significant degradation if there is not co-evolution among each DOTMLPF element. NCW is all about deriving combat power from distributed interacting nodes with significantly improved access to information. The increase in combat power is the result of the nonlinear portion of the dynamical structural behavior in the network. The effectiveness of linking mechanisms and processes means links that provide the best performance under a wide range of battlespace environments and conditions. Nodes do things: sense, decide, and act. Information, as both input and output, passes over links from one node to another. Nodes, or entities, are defined by their roles (i.e., sense, decide, act), responsibilities, tasks, decisions, and the nature of the information and products exchanged with other nodes/entities (that is, their degree of coupling).

The key to understanding the roles and responsibilities among battlespace entities is to focus on the processes that turn raw data into knowledge. Data are individual facts, measurements, or observations. Information is assembled, fused, reconciled, etc. data in an operational context. It requires little, but some, interpretation. Knowledge is interpreted information that provides explanation, usually via cognitive models. This is an interesting approach to classic target systems analysis which focuses more on the physical relationships between physical entities. The marriage of these approaches led to the overlapping model that contains a physical domain and a cognitive domain that is connected via an information domain. The source of the increased power in a network-centric operation derives in part from the increased content, quality, and timeliness of information flowing between nodes. Hence this overlapping model can be used for both enemy-as-a-system analysis (or system-of-systems analysis) as well as friendly system analysis.

What is different from today's sensors and actors? Basically this: intelligence is transferred from the platforms to the info structure; sensors are decoupled from weapons; sensors and weapons are decoupled from actors; and new actors and sensors are developed. NCW does not eliminate uncertainty in warfare, though. The fog of war is about the uncertainty associated with what is going on, while the friction of war is about the difficulty in translating the commander's intent into actions.

Information Age Warfare (IAW) makes a reductionist approach to campaigns more difficult due to the compression of time and space, the collapsing of traditional,

hierarchically clear organizations, integration of much more information into orders, and the emergence of distributed collaboration. The result is a need for greater integration between the heretofore separate planning and execution processes, requiring more timely interactions between the two, and portents an ultimate merging of these two processes into a seamless form of command and control.

SOW Task 3: Effects-based Coalition Operations

The contractor shall research and identify how EBO-related considerations could apply in a coalition environment. Update the existing CONOPS to reflect such coalition aspects upon Government approval.

This task was cut short halfway through the project when other priorities intervened. However, Dr McCrabb did produce one significant research paper in those few months. It is located at Appendix B. The significant findings are listed in the Introduction to this report.

SOW Task 4: EBO Experimentation

The contractor shall develop scenarios, trials, stories and plans for effects-based experiments. For those cases where the data is not available, develop experiment data. Participate in the experiment. Experiment participation shall include user training, data collection and reduction, and analysis.

The final task dealt with experimentation. Our primary sub-tasks were to develop the scenario, plans, models, and data to support the EBO ATD developers in their experiments. The main vehicle for this was the scenario Operation DENY FORCE. The detailed materials are found in Appendices. Appendix C is the scenario and background material. Appendix D is the Joint Air Operations Plan. This section briefly summarizes ODF and how it was used.

Operation DENY FORCE (ODF)

ODF is a scenario designed to support a test case that highlights technologies developed by AFRL. The scenario is completely notional but reflects the types of mission and circumstances US military forces faced since the mid-1990. It is set in 2010 and makes use of a Global Strike Task Force (GSTF) and Air Expeditionary Task Force (AETF), supported by an Advanced Technology Air & Space Operations Center (AT CAOC)[8], the heart of the Command & Control Constellation (C2C), and other systems such as Global Hawk unmanned aerial vehicles and the Advanced Technology Deployable Ground System.

The purpose of the campaign-to-engagement level scenario is to show how PBA (Predicative Battlespace Awareness, especially its Intelligence Preparation of the Battlespace, IPB, component), EBO (Effects-based Operations), Agile Combat Support (ACS) and other tools and processes, all tied through the Joint Battlespace Infosphere

8 This was the name of the next generation CAOC at the time ODF was developed. It has since been identified as CAOC Block 10.2.

(JBI), work together to help achieve a Joint Force Commander's (JFC) intent quickly, decisively and using fewer resources than current practice. These tools enable an effects-based approach.

The scenario follows a course of events from a crisis through the planning, execution and assessment of a campaign plan with emphasis initially placed on developing and selecting a course-of-action (COA). The idea was that as AFRL research and development (R&D) activities expanded, the scenario detail would expand to balance the planning focus (and the assessment activities that supports COA selection) with execution and combat assessment activities. The story is weaved throughout. The first three steps of Crisis Action Planning (CAP) developed the crisis.

Summary and Areas for Future Research

Summary. This Technical Report summarizes work done by DMM Ventures Inc., through our Principal Investigator, Dr Maris "Buster" McCrabb, for the EBO ATD. In this final section we briefly summarize the main points then discuss several areas for future research. The first area is the follow-on from the EBO ATD: Dynamic Air and Space Execution and Assessment (DASEA) Critical Experiment (CE). In this section we discuss several technologies or particular importance to assessment: collaboration, analysis in an environment of overwhelming data but little information, and visualization. The second area extends the idea of an effects-based approach to the research and development and command and control acquisition communities: it briefly describes how an effects-based approach could be applied to R&D and force structuring activities. Finally, the third area consists of several technologies that can significantly enhance EBO beyond those immediately identified with assessment: agent-based discrete event simulation, behavioral modeling, and systems analysis under uncertainty.

The main task assigned our PI was to develop the operational concept for effects-based operations. This task basically involved developing concept-of-operations documents and briefings. In its most basic terms, EBO is an approach—a way of thinking—to planning, executing, and assessing military operations that focuses on the results of military operations—and the explanation of how those results came about—rather than the actions—sorties flown, rounds fired, or tons of relief materials delivered—of military units. As such, it spans the gamut of military operations from humanitarian relief to major theater war. It accounts for lethal and non-lethal applications of force delivered kinetically or via non-kinetic modes. EBO incorporates and expands upon traditional approaches such as targets-based and strategy-to-task. The most significant challenge for EBO is predicting and assessing how physical actions result in behavioral outcomes.

The main focus of the EBO ATD was operational-level effects-based planning. In that, the main focus area was an effects-based Joint air estimate process. The core of that activity is developing and analyzing an effects-based course-of-action (COA). A COA answers the *what*, *how*, *why*, *who*, *where*, and *when* of military operations. Traditionally, the *why* referred to the rationale for the *what*. From an effects-based perspective, the *why* answers rational but also the idea of mechanism, or causal linkage, that explains *why* the *how* accomplishes the *what*. Though simple to state, and only a bit more complicated to flesh out in terms of definitions and procedures, in reality an effects-based approach to

campaign planning proved difficult to implement. Immense challenges remain.

DASEA. As the EBO ATD focus narrowed to effects-based planning, it became evident that additional research was needed in the critical area of effects-based assessment. This project became the DASEA CE. Key to taking an effects-based approach to conflict is an ability to assess the outcomes—or effects—of actions taken to achieve those effects. Historically, assessment activities focused on the actions themselves and, at best, on progress towards achieving specific objectives, normally tactical objectives at component levels and operational and campaign (or theater) objectives at the Joint Task Force or Combatant Command level.

As the CE is just starting at the time of this TR, there are many more research areas to be discovered than can be covered here. This TR addresses three areas that seem of most importance: collaboration, analysis in an environment of overwhelming data but little information, and visualization.

Collaboration. This capability is needed for both effects-based planning and effects-based assessment but rather more for the latter than the former. The reason is that assessment is more complication when dealing with higher-order effects. Because of that, the analytic expertise is not normally available in a military command center like a CAOC. Further, the analytic capability is rarely centralized regardless of where it is located. Thus collaboration becomes more the norm for assessment. Unfortunately, this collaboration today consists largely of chat rooms and whiteboard applications rather than true collaboration where individual analysts are working on a common problem. It is not unlike the shared awareness problem described above in the discussion on EBO and IO. The second issue for collaboration is the higher-order effects make the cumulative effect a multi-faceted one. This means differing communities working the assessment piece which means a significant problem of interoperability of information. This too is similar to the issue raised above in SOW Task 3 dealing with Coalition issues. There the idea was raised of using an ontology base to facilitate information interoperability.

Partial Information. As the speed of the control apparatus strives to keep up with the speed of command, the time available for individual steps in the assessment process becomes less and less. One upshot of this is that analysts (whether human or machine) will have less and less complete information upon which to draw. Furthermore, the information may be in raw form. This is because the "Task, Process, Exploit, Disseminate" (TPED) formula is being replaced by "Task, Post, Process, Update" (TPPU) model. This is an attempt to get information, though not analyzed, to the consumer quicker. What is needed is a process and set of technologies that can assist in this environment. It would need to provide available information at various stages through the process since the press of events might not allow a commander to wait until all available data is in. Furthermore, it might have to deal with uncertain or conflicting data. Even normalized data faces problems of similar words having the same meaning and the same word having multiple meanings.

Visualization. A picture might really be worth a thousand words but the challenge is determining what 1000 words the picture is portraying. Graphics do allow more information is be grasped quicker than text. On the other hand, the ambiguity in graphics

is generally higher than in well-structured text. The key research is to find the balance between these advantages and limitations and craft ways that more information, in tailored formats, can be presented. We believe regardless of the solution, some sort of drill down/drill into capability must be provided to handle the different command styles where one commander wishes a lot of detail on some items and not others while another commander has different preferences. EBO offers its own challenge to visualization that is especially evident in assessment. That is the challenge of how to display higher-order effects, especially psychological and sociological effects. One of the areas left unexplored in this project was this ramification with EBO and IO.

Effects-based R&D and Force Structuring. The second research area we think offers great payoff is how to move from traditional R&D to acquisition models and more towards an effects-based approach. This final subsection looks at two ideas that might be considered for future research. The first we call "effects-based development" and the other we call "effects-to-force structure."

Effects-based Development (EBD). Just as EBO methods widen the aperture on the variety of effects that can achieve a commander's campaign objectives, EBD—within the wider transformed DOD acquisition process—sweeps much more broadly in search of capabilities than traditional defense acquisition. The newly established Joint Capabilities Integration and Development System (JCIDS) represent a bold enabling step for EBD. JCIDS embraces all government agencies, industry and academia to improve existing capabilities and develop new capabilities defined by warfighter needs. Although JCIDS—like effective EBD—demands a rigorous comprehensive approach to defining capabilities, the resulting benefit to EBO of the resulting better developed, operationally integrated, and effectively supportable capabilities will be substantial. In order to synchronize the many programs that comprise an enterprise-level capability, the enterprise creates a *capability architecture* to define and direct the development paths of its constituent programs. In turn, the constituent programs align themselves to the enterprise's capability requirements through funding and oversight of current initiatives, such a network-centric operations or service-oriented architectures. EBD seeks to imbed EBO-enabling in the capability architecture at the enterprise level, thereby advancing the case for effects-based current initiatives, while at the same time ensuring operationally relevant development of effects-based technologies at both the program and individual initiative level. In essence, EBD's mission is to support a top down/bottom up collaboration on behalf of EBO-enabling capabilities. The use of enterprise architectures to "reverse engineer" from a SV-5 to an SV-9 (normally a forecast of future technology evolution but now recast as a projection of future technology *needs*) to a kit of technology projects offers one way to accomplish effects-based R&D.

Effects-based Force Structuring. The idea here is fairly straight-forward. What is needed is the ability to go from a set of desired effects to the right mix of force capability packages that, under specified conditions, can—with some probability—attain those desired effects. Likewise the same ability showed be able to go from a set of force packages and, again under specified conditions and at some identified level of probability, forecast what set of effects those capabilities could achieve. During the EBO ATD, procedures and technologies where developed that identify the set of actions

needed to attain some set of desired effects. What was lacking was a sense of force structure requirements or how a given force structure hampered or helped the achievement of a set of effects. This research is sorely needed. It seems possible that a knowledge base populated with the right models could achieve this capability. The models would have to include ones on force packages and ones dealing with actions-to-effects (as designed during this ATD). The key ingredient then becomes the model of military operations.

The last area for further research we look at are three technologies that can significantly enhance EBO as well as other applications to C2: agent-based discrete event simulation, behavioral modeling, and systems analysis under uncertainty. Since we are not a technology firm per se, these paragraphs were necessarily be brief and focused mainly on how the technologies could enhance EBO and other C2 activities.

Simulation. A key element of EBO is that effects percolate through and enemy-as-a-system through a series of direct and indirect effects that result in cumulative effects. This movement and agglomeration takes time; effects have delay, persistence, and decay. Planners and assessors alike face the problem of anticipating these effects at various instances of chronological time. To do so requires some sort of simulation of the possible outcomes of present events (actions) plus how the present (or near present) effects of those actions accrue over time. Furthermore, planners need to simulate adversary actions and effects also. Indeed wargaming requires planners to determine the action/effect then reaction/effect of friendly and adversary plans over a broad range of times, events, and environmental states.

Modeling. Military planners have modeled adversary physical systems and fielded forces for eons. What has proved elusive is modeling intent and other psychological and sociological elements. Commanders have long realized that success comes from bending the will of the adversary to one's own but understanding the causal linkages between physical actions and behavioral outcomes has been much more guesswork and art than science. Unlike many aspects of physical science, behavioral science is inherently non-deterministic.

Systems Analysis. Even with models, the next challenge is analyzing them under conditions of uncertainty. The most common area of research is Bayesian models. The key operational characteristics of any analytic tool must be the transparency of the analysis, the support to any findings, and the ease of understanding by non-specialists.

Appendix A: Explaining Effects

> To invent without scruple a new principle to every new phenomena, instead of adapting it to the old; to overload our hypotheses with a new variety of this kind; are certain proofs, that none of these principles is the just one, and that we only desire, by a number of falsehoods, to cover our ignorance of the truth. *David Hume,* A Treatise of Human Nature.

Effects-based operations seem to be on everyone's lips these days. The authors of *Joint Vision 2020* and *Air Force Vision 2020* speak often of "effects" though neither offers a definition. The USAF took a stab at defining and describing effects (and, by extension, effects-based operations) in Air Force Doctrine Documents (AFDD) 2, *Organization and Employment of Aerospace Power*, and 2-1, *Air Warfare*. For the reasons stated below, both these efforts fall short. If effects-based operations is truly to give commander's another, legitimate tool to use, the primitive term *effect* and its various modified terms such as *direct effect* or *indirect, complex, cumulative* or *cascading effect* must be further defined, explained, and expanded. This essay attempts those tasks.

I will start by examining AFDD 2 and 2-1's discussion on effects and where and why I think they fall short. The section after that defines and describes the primitive *effect* and four of its indispensable modifiers: *direct, indirect, complex, cumulative* and *cascading*. In the third section, I take these terms of reference and apply them to the ideas found in *Joint Vision 2020* and the Air Force's complement to it.

Words or phrases in ALL CAPS type indicate places I am offering a primitive or conceptual definition.

Where AFDD 2 and 2-1 come up short.

Air Force doctrine writers do attempt to define and describe effects. This stands in contrast with earlier failures to precisely define such basic terms as airpower and strategic bombardment. A DIRECT EFFECT is defined in Air Force doctrine as: "Result of actions with no intervening effect or mechanism between act and outcome. Direct effects are usually immediate and easily recognizable." An INDIRECT EFFECT is defined as: "Result created through an intermediate effect or mechanism to produce the final outcome, which may be physical or psychological in nature. Indirect effects tend to be delayed and may be difficult to recognize."[9] This formulation, while correct in its intent, must be incorrect in its particular. There cannot be a direct linkage between action and result without a cause whose explanation I will call a mechanism. There can be, however, an intervening effect that causes an INDIRECT EFFECT. AFDD 2, furthermore, makes some effort to describe the connections between desired effects and the various levels of war. "Effects at the strategic level of war include destruction or disruption of the enemy’s center(s) of gravity (COGs) or other vital target sets, including command elements, war-production assets, and key supporting infrastructure that impairs the enemy’s ability or will to wage war or carry out aggressive activity." "Operational effects such as theater air superiority, command and control (C2) decapitation, and battlefield isolation are the tools

9 Air Force Doctrine Document (AFDD) 2-1, *Air Warfare*.

with which the operational air commander supports the overall strategy."[10]

There are several limitations in Air Force doctrine. First, the primitive *effect* is defined only by implication. In both definitions above, effect equates to result. As stated in the next section, I agree with that part of the formulation. A more serious shortcoming is melding effect with action without any further elaboration. An example is disruption (see below). It is listed as an action and an effect on the very same page. As I hope to make clear, there is a time when that is correct and a time when it is not. Understanding effects-based approaches crucially depends upon making clear these distinctions. Likewise, Air Force doctrine makes no distinction whatsoever between effect and objective *at any level of abstraction.* (See, for example, AFDD 2-1 Chapter 2.) This fault lies at the root of the claim there is no difference between effects-based approaches and objectives-based approaches such as strategy-to-task. I show in the next two sections why that mindset limits the power of an effects-based approach. Next, these documents contain scant discussion on how effects combine but say they do. "The effects of dislocation, destruction, and diversion *create* delays." "Today, precision engagement and increased intelligence capabilities allow simultaneous and rapid attack on key nodes and forces, producing a *cumulative effect* that overwhelms the enemy's capacity to recover."[11] This failure really shortchanges not only the idea of effects but also effects-based approaches. In fact, it is tracing and understanding the interplay between direct and indirect effects (what I will more elaborately define as complex or cumulative effects) and how that interplay in turn leads to other effects of much greater magnitude (again in more detail below but what I define as cascading effects) that is the unique contribution of effects-based operations to the body of military theory. Another criticism is the doctrine writers use *mechanism* in a curious manner. In one sense, it might appear effect and mechanism is identical ("no intervening effect or mechanism"). In another sense, it might seem *effect*, as *result*, is different from mechanism. The third sense might be that mechanism and effect are different but both can be intervening variables. Again, these distinctions are essential to any understanding or application of effects-based approaches. Lastly, these doctrine documents separate effects from their objects. This is misleading at best and confusing at worst. Effects are always tied to an object. MECHANISM is the explanation of cause. Since the publication of the ACC White Paper in 2002, *mechanism* is now called *causal linkage*.

An OBJECT is the focus of attention; the purpose, aim or goal of a specific action. For example, a desired effect of "isolate the battlefield" has "isolation" as the effect and "battlefield" as the object. Objects always lie within the context. By specifying the object, planners also provide the boundary between phenomena. This is essential, especially in other than trivial circumstances, because otherwise the problem space can become huge and intractable. Indeed, "isolating the battlefield" in a context such as the Gulf War would be daunting. Better to seek "isolation of the KTO" or "isolate the Republican Guards from their means of supply."

Defining and describing effects.

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10 AFDD 2.

11 Neither AFDD 2 nor 2-1 lists *cumulative effect* in their Definitions section.

In this section I build definitions from the bottom up starting with the primitive *effect* then move on to more intricate terms by way of four basic modifiers: direct, indirect, complex, cumulative and cascading. I next describe a set of effects (illustrative and in no way definitive) using a top down method. This is important. Some might argue that "moving a tank battalion" or "pressing a key on a computer keyboard" could create an effect. Undoubtedly true. But what seems more useful from a commander's point of view is "what set of actions must I put in motion to achieve such-and-such an effect?" "Moving…" and "pressing…" are actions, not effects. "Mov*ed*" or "Press*ed*" can be effects. The distinction is not trivial because the effect relies very much on being able to explain the cause. Furthermore, executing actions then determining what effects they achieved seems backwards. Finally, along the way I point out related terms such as objective, end-states, strategic aim, conditions, events, strategy, ends, ways, means, risk, concept of operations (CONOPS), and course-of-action (COA).

AFDD 2-1 is right in saying that an EFFECT is the result of some action. In other words, actions cause effects. Now the action can be direct or indirect. This presents a fundamental point: *whether an effect is a direct effect or an indirect effect depends generally upon point-of-view*. An effect is a DIRECT EFFECT if it directly results from a direct action. It is an INDIRECT EFFECT if it results from the effect of some previous action or set of actions. I say “generally” due only to the differences in visibility that arise when viewing from different vantages. For example, seeing the direct effect of a bridge span dropping into a gorge seems rather simple compared to "seeing" how a disrupted transportation system affects the morale of frontline troops. By way of example, if I can say, “If I take this action, then this result will occur.” I have made a statement of a DIRECT EFFECT. If I can say “If I take this action, then this result will occur and the impact of that result will, in turn, cause some second result.” I have made a statement about a DIRECT EFFECT and it’s causing an INDIRECT EFFECT.

An effect is not an objective in this sense. An objective, goal, or aim (these are interchangeable) exists generally only as a state. It exists regardless of action. For example, “regional stability” is a desired state or objective often seen in the US national security strategy. By itself, it is not a desired effect. An effect is a result. It requires the presence (at least) of some previous action. Given an action, though, an effect can exists as a state. The linkage between action and effect is mechanism. However, the definition of MILITARY OBJECTIVE in Joint doctrine is slightly different than the definition of objective as used here. In the Joint dictionary, a military objective is “a derived set of military actions to be taken to implement National Command Authorities guidance in support of national objectives. A military objective defines the results to be achieved by the military and assign tasks to commanders.” Hence, the Joint definition links actions to outcomes. How those two are linked it left unsaid.

A MECHANISM (causal linkage) is the explanation on how an action causes an effect. Mechanism explains cause. As used here, mechanism is adapted from natural philosophy: the doctrine that all phenomena are explicable by causes and principles. The adaptation is necessary because natural philosophy limits this doctrine to natural phenomena explained by material causes and mechanical principles. This wider definition is grounded in behavioral sciences such as psychology and especially, as used here, political economy.

However, the distinctions made in natural philosophy can be useful. For instance, one can call “natural mechanisms” those that explain physical results predominately by reference to material causes and mechanical principles, either classical or quantum. I would hesitate, however, to call results not mainly explicable by material causes and mechanical principles “unnatural mechanisms”!

Continuing the example from above, if I can say, “If I take this action, then some result will occur because of one thing and/or another.” I have made a statement about a DIRECT EFFECT and its MECHANISM (“one thing”) or MECHANISMS (“one thing and/or another”).

Mechanism should not be confused with the dependencies or linkages found, for example, between centers-of-gravity (COG) or target systems. While indeed these may be similar (or identical) elements, their purposes remain distinctly separate. Mechanism explains the causal connection between an action (taken either directly or which is a result from a previous action) and the result (or effect). Linkages explain the connections between elements within a COG or target system. These linkages exist regardless of the action taken *by a third-party agent*. That electrical power (a target system) has an important connection to an electric rail network is highly likely. It is also highly likely that this connection exists regardless of whether I (the nefarious agent) act against it, or for it (for instance, protecting a friendly target system). This (again) emphasizes the fact that *effects are point-of-view dependent.*

One way to illustrate mechanism is to look at some classic theorists to see how their theory explained mechanism.

♦ Karl von Clausewitz: if you defeat an enemy’s fielded forces then a rational leadership will accede to your demands because with their fielded forces their country is undefended.

♦ Guilio Douhet: if you terrorize the population through aerial attack then a rational leadership will accede to your demands because if they do not, then the population will rise up in rebellion.

♦ R.A.F. Air Marshall Sir John Slessor: if you interdict the infrastructure of the supplies to the fielded forces then a rational leadership will accede to your demands because their fielded forces will more likely be defeated by your forces due to a weakening in their combat power.

♦ Thomas C. Schelling: if you threaten things leadership values (like their fielded forces), then they will accede to your demands if the cost of losing those things they value exceeds the cost of acceding to your demands.

♦ Col (ret.) John A. Warden, III USAF: if you isolate leadership then they will be prevented from doing something that would thwart our will. They submit because the imposed paralysis prevents them from doing anything else.

One further point needs to be made regarding the primitive *effect*. Just as in systems theory, a result can be viewed as an output or an outcome and further the output/outcome

in turn can be the input (that is, an "action") into another sub-system. The difference between output and outcome is the presence of intervening variables. In this discussion, those intervening variables are other direct/indirect effects that combine with the "original" effect (recalling, this is point-of-view dependent) to form what I call a complex effect.[55]

Complex effects. The writers of Air Force doctrine probably had this concept in mind when they wrote of cumulative effects. Sometimes this is referred to as “synergistic effects.” Why not just use one term or the other? The reason is that each term aptly expresses a particularly useful idea and the term "synergistic, complex and cumulative" is unwieldy. From *complex* comes the idea that effects play off and interact with one another. From cumulative comes the temporal aspect of effects: they have persistence and therefore accumulate over time.[56] Thus, this essay's position is that COMPLEX EFFECTS describe the intertwining of effects at an instance of time. Back to our example, recall that if I can say, “If I take this action, then this result will occur and the impact of that result will, in turn, cause this second result.” I made a statement about an indirect effect resulting from a direct effect. If I combine a statement about a direct effect and another direct effect or an indirect effect, I have a statement of a complex effect. To clarify, I introduce capital letters for actions and effects and numerals for mechanisms.

“If I do A then B will result.” is a statement of direct effect.

“If I do C then D will result” is also a statement of direct effect.

“If I do A then B will result and the effect of B will, in turn, lead to E.” is a statement of direct effect (B) and indirect effect (E).

“The impact of B plus the impact of D will lead to F.” is a statement of complex effect; two direct effects (B and D) combined.

“The impact of B plus the impact of E will lead to G.” is also a statement of complex effect; this time a direct effect (B) plus an indirect effect (E).

Adding “…because of 1, 2, and 3.” to any of those statements adds mechanisms: “If I do A then B will result because of 1, 2, and 3.”; “The impact of B plus the impact of E will lead to G because of 4, 5, or 6.” “If … then … because of ….” can be called an “effects statement.” I usually add to it to make an “effects paragraph.” “If <action taken> then <effect on some object occurs> because of <mechanism> in order to achieve <purpose> and using <resources>. The evidence of <action, mechanism, effect> is <indicator>.”

A CUMULATIVE EFFECT refers to the phenomena of complex effects over some period. This also fits nicely with a theory of campaign planning where strategic aims are broken down into END-STATES, defined by sets of *conditions* achievable by a set of *events*, whose attainment achieve the *strategic aims*. “The impact of B plus the impact of D will lead to F over the next four days because of 7, 8, and 9.” is a statement of a cumulative effect and its mechanism. It is important to note that the temporal aspect of an effect applies to each primitive. A direct effect can be “delayed” in the sense that it is not instantaneous just as indirect and cumulative effects are delayed by definition. This is

another example of the point made often: *effects are point-of-view dependent*.

Another reason I prefer the term complex effects is that complexity theory offers useful tools in describing and analyzing complex effects. Complex adaptive systems (*cas*) exhibit coherence (or order) under change through conditional action and adaptation without requiring central direction. As becoming almost commonplace now, warfare is a highly nonlinear phenomenon. No complex, nonlinear system can be adequately described by dividing it up into subsystems, analyzing those (in even the most detail possible), and then "re-assembling" the system. The whole really is greater than the sum of its parts. In studying a complex system one must follow the information: how internal models are constructed and used; how the elements within the system perceive their environment; then how those agents adapt to changes both due to inputs to themselves and changes the agents perceive in their environment.

What does this have to do with effects? Foremost, to understand effects requires adopting a systems perspective. Behaviors (recall these are generally the results of second, third or higher level indirect actions) of *cas* depend more on the interactions between the agents as they adapt to their environment and one another than the actions of any given agent or set of agents. Understanding and tracing effects as they ripple throughout a system is one of the toughest requirements in adopting an effects-based approach. Finally the "whole is greater than the sum of its parts" leads to the concept of emergence or the systemic behavior not identifiable from studying the behavior of the parts. This, of course, is well known in group theory where the interactions (e.g., bargaining) between members in a group result in positions not necessarily predictable from analyzing the preferences of each individual member of the group. In effects theory it accounts for cascading effects.

Cascading effects. Key to understanding cascading effects is knowing that an overall "system" such as an adversary might present is in reality a system of systems where each sub-system has its own effectiveness and efficiency measures. Furthermore, in anything but a trivial system, the interactions between sub-systems result in the whole being more than the sum of its parts. CASCADING EFFECTS are defined as those direct, indirect or complex effects' *trace* to their impact at the systemic level when viewed from that perspective. Complex adaptive systems theory speaks of phase transition points where some small level of effort (for example, the same level of activity), while previously bringing an elastic set of effects, all of a sudden generates much greater results for the effort expended. *At this level only*, cascading effects then resemble *Poor Richard's Almanac*: the attacks on German oil production reduced the available flying time for German student pilots which meant they were less prepared to stop Allied attacks on oil facilities which lead to further reductions in flying time which…

Physical and behavioral effects. At the next level of abstraction, though, the comparison with Ben Franklin's cute saying breaks down. That level is where physical effects merge with behavioral effects. Physical effects arise from actions taken against tangible elements in a physically delineated context. Behavioral effects arise from actions (recall, these can be direct actions or "effects as actions") taken against intangible elements in a behaviorally delineated context. The problem really arises at the operational level. At the tactical level, in a conventional military context, bombs and bullets are the common currency that results in relatively well-defined (and physically identifiable) effects. At the

strategic level of leadership, policies resulting from behaviorally described actions, have little “physical” content to them. While not welcomed, for assessment purposes, it is expected. At the operational level, however, physical and behavioral effects merge in ways that do not allow precise separation of one from the other. This is not just the behavioral impacts of the fog, friction, fear and frustration of warfare though it does clearly include these. Rather this deals too with how the effects (or results) of physical actions influence the behavior (as well as the psychology) of an adversary.

Destruction as an effect. There are eleven effects variously described in Air Force doctrine. This essay examines three. Destruction is perhaps closest to a "pure" physical effect. Disruption, which can be mainly a physical effect, mainly a behavioral effect or some combination, is included to provide an illustration on how an effect can be broken down, e.g., for planning purposes. Finally, isolation illustrates the crossover from physical to behavioral effects.

"Aerospace power’s most obvious wartime force application is the destruction of targets. Its objective is to create maximum, long-term damage the enemy cannot recover from in the immediate future or for the duration of the conflict…. Destruction of critical targets can also lead to several other effects such as disruption, diversion, or delay of enemy forces." Note two things. One is the missing link between action ("force application") and result (or effect). As described above, this is the causal model so critical to an effects-based approach. Secondly, note the reference to indirect effects, though there is not any specificity of whether "disruption, diversion, or delay” is further physical effects or some combination of physical and behavioral effect. Nor, as noted earlier, is there any discussion on how these effects (of whatever kind) combine such as "Through the combination of destruction, disruption, diversion, delay, and deception, aerospace power is capable of denying an enemy the ability to offensively employ his forces."[12]

Though an almost pure physical effect, destruction can be derived as a necessary or even a sufficient effect using a top down effects-based methodology. EBO must encompass target-based approaches and one effect classically associated with targets is destruction.

Disruption. During Operation ALLIED FORCE, the campaign against Serbia in 1999, an explicit mission was to disrupt Serbian military and paramilitary forces, especially those in and around Kosovo, so as to keep them from killing and harassing the Albanian Kosovors. Imagine for the moment that planners sought to attain this goal using an effects-based approach. How might they go about it? The caveat is that what follows is pure illustration. It no way presents a definitive view on what constitutes “disruption” or how commanders should go about their business. As always, we start with a working definition:

Disruption means that an entity or object (for example, the Serbian forces) cannot operate as normally or as they may wish.

Then we look for reasons this might occur. These, of course, are mechanisms. One approach is to use a model, originally developed by USAF Col John A. Warden, III, that

12 AFDD 2.

is now found (in two varieties) in AFDD 2-1. Here are some examples:

The object of our desired effect cannot operate as normal because of a lack of coherence. This can arise from:

♦ A reduction or elimination of direction (a command and control or leadership function).

♦ A reduction or elimination of necessary capabilities the object requires operating normally (a system essential like power or, in this case, supplies like ammunition or petroleum products).

♦ A reduction or elimination of connectivity, either physical or electronic, needed to operate normally (infrastructure like communications or needed road networks).

♦ A reduction or elimination of the people required to operate the system.

♦ A reduction or elimination of the forces required to protect the object (fielded forces such as air defense systems, for instance).

Note several things in this example. The first is that disruption can be a matter of degree ("reduction or elimination"). Second, analysis is necessary to make these causal connections. While generic models (like Warden's) are useful, only until context is added can they produce the kind of information planners require. On the other hand, such models are very useful to organize thought and organize search for the required information. In a world of an increasingly amount of data, knowing what you are looking for can be a crucial first step in finding it. Another point is these mechanisms can have indicators that can be observed such as a road network or even people, like a repair crew, needed to maintain the road network. Finally, the causal connection between, for instance, a lack of fuel and incoherence, can be tested either *a priori* (say, in a wargame) or during operations. This is essential to establish an assessment on how an effects-oriented operation is progressing. Most importantly, this methodology points up the point-of-view and contextual relationships that are crucial to delineate. How tightly couple the adversary system is will dictate how much coherency not only exists in the system, but is required of the system. For example, cooperation is the loosest bonding between military forces of two (or more) nation-states in the planning, execution and assessment of operations. It may or may not involve efforts towards a similar end or use of similar means. Coordination, on the other hand, does require some conscious desire towards a common end or use of a common means. But it does not require any formal support/supporting arrangement. Synchronization is the next step towards combining efforts and does require specification of which military force will be supported by another in particular circumstances. However, military forces retain their individual identity. To be integrated at some level forces must be mixed and matched towards not only a common goal, but use common means and lose their individual identity.

The next step is viewing the connections between these mechanisms in order to find the trace that might lead to the highest payoff. This process will not be elaborated here. Next, a set of actions is developed that achieve the various mechanisms. These actions become

tasks that executing units perform based, generally, upon some set of targeting and weaponeering data matched against the threat and forces available (or required) to execute. The results of those actions are assessed with an eye towards whether they attained (or are attaining) the commander's intent.

Another point worth highlighting here is the implied presence of direct, indirect, complex, cumulative or cascading effects. These implications come from viewing, in this case, the enemy as a system (or, if you prefer, a system of systems). Electrical power, for example, is a target system associated with many capabilities: command (viewed, by Warden, as part of the leadership COG; viewed by others as a COG in its own right) generally requires power to operate the radios, telephones, switching networks, (increasingly) computers, and so forth that enable control. Command without control is a meaningless concept. Electrical power (EP) might also be crucial to an electrical rail system part of the infrastructure COG (again using Warden's scheme). At the same time, most adversary leaders can be expected to understand this crucial role of electrical power and take steps to defend their systems. Hence, the linkages and dependencies between fielded forces and EP.

Isolation as an effect. This problem of specificity becomes more apparent when one considers the discussion in Air Force doctrine on the effect of isolation. First of all it is not listed specifically as an example of a deterrent, contingency or war-winning action (recall the discussion above on the Air Force doctrine conflating "action" and "effect") but is directly mentioned under the action "air siege" and indirectly under the war-winning action of "halt." The most complete discussion is found in AFDD 2-1.3, *Counterland*:

> A direct attack strategy tends to produce intense localized RESULTS with fewer disruptive EFFECTS across the entire enemy army. Psychologically disruptive effects, however, may prove to be an added benefit… A key part of the interdiction planner's task is to analyze the enemy army for key vulnerabilities that, if attacked, will have a disruptive effect across significant portions of the enemy force. The presence of such targets, and our ability to attack them, will often determine whether disruption or destruction will be the primary effect mechanism planned for the air interdiction effort.

What is noteworthy here is the top down approach taken by the writer. Given the topic of AFDD 2-1.3, it is not surprising it focuses almost exclusively on force-on-force considerations. But even here, the approach is to start from the army level down, not from individual targets (such as a tank) up. Note also the explicit tie between physical and behavioral effects and the tie of both with strategy. This supports the argument that indirect and complex effects are present even in force-on-force approaches and by understanding them better planners can be more confident that those impacts will be beneficial (from the planner's point of view) rather than not. Note too the acknowledgement of the importance of center-of-gravity (COG) analysis (called there "key vulnerabilities"). This analysis is central to effects-based approaches (but outside this essay's scope) because it is through that work that effects, of all stripes, are traced and understood. One final primitive must be defined and explained before we leave this

section.

An INDICATOR of an effect is not an effect; it is defined as an observable or unobservable manifestation of action, cause or result. They “are data items evidencing the phenomenon of concern.” It indicates the existence of the effect (action, cause) but is not the effect (action, cause) itself. While it might seem useless to speak of "unobservables" this is not so. One danger would be to forego an action, for example, because it or the anticipated, resulting effect was unobservable. "Not visible," does not mean "not there." Indeed inferential methodologies are widely employed that offer means of deriving missing information. Indicator also needs to be distinguished from metrics. One way is to consider standards and conditions. STANDARDS consist of measures and criterion. According to definitions found in both the Joint Universal Joint Task List (UJTL) and the Air Force's Task List (AFTL) a "MEASURE provides the basis for describing varying levels of…task performance. A measure is directly related to a task." The same sources define a CRITERION as "acceptable levels of performance. It is often expressed as a minimum acceptable level of performance." A FUNCTION is an assigned duty or task. “CONDITIONS are variables of the environment that affect the performance of tasks.” TASKS are work to be done. They consist of a related set of actions done for some purpose.

JV 2020 and *Global Vigilance, Reach & Power.*

Both these vision documents are replete with references to *effects*. There is a marked difference, though. In *JV 2020*, "effects" can be found in the phrases "mass forces or effects" or "mass forces and the effects of [fires, dispersed forces]." That usage is never found in the Air Force's vision document. Since these references are a small minority in the Joint document perhaps not too much should be made of this. On the other hand, the phrasing might indicate an awareness (not, again, found in the Air Force document) of the distinction between the action (or at least the implementers of action--forces) and the result of action, that is, the effect. Previously I mentioned the conflating of action and effect in Air Force doctrine. Unfortunately, I have yet to find any sustained discussion on effects (as the word is used in both vision documents and Air Force doctrine) in Joint doctrine, even the most recent works.

Besides this perhaps trivial point, both vision documents, while not taking the time to expand on the precise definitions and nuances of effects, do portray a somewhat different environment than previous works. The Air Force document in particular makes several important points. First is the explicit recognition that the Air Force's mission is no longer simply to "fly and fight" but rather to "operate aircraft and spacecraft" to "produce the exact effects the nation needs." In other words, they have added why the Air Force flies and fights. The reason for being is not to fly or fight, but rather to “produce the exact effects the nation needs.” Second, *Global Vigilance, Reach & Power* rightly points out that this is first accomplished by developing "commanders *who think* in terms of exploiting the whole aerospace continuum--leaders able to employ forces that produce the desired effects…" Unfortunately, old habits die hard. Under "The Method," the Air Force vision statement reverts to the past practice of equating effectiveness with targets serviced ("some 200 targets per day"), rather than effects achieved. This habit is not found in *JV 2020*.

Indeed the Joint document comes closest of the two in elaborating indirect and cascading effects. "In a conflict, for example, the presence or anticipated presence of a decisive force might well cause an enemy to surrender after minimal resistance. During a peacekeeping mission, it may provide motivation for good-faith negotiations or prevent the instigation of civil disturbances." Like the Air Force vision, *JV 2020* emphasizes the crucial role the commander plays in an effects-based approach to warfare, the wide types of force that can trigger the action-cause-result chain, and the importance of assessment to EBO: "The concept of precision engagement extends beyond precisely striking a target with explosive ordnance. Information superiority will enhance the capability of the joint force commander to understand the situation, determine the effects desired, and select a course of action and the forces to execute it, accurately assess the effects of that action, and reengage as necessary while minimizing collateral damage."

Summary

The main task of this essay was to elaborate the definitions, descriptions, and explanations of terms associated with effects-based operations (EBO). It is my contention that in order to make the EBO concept at all useful in any real sense (as opposed to, for instance, a marketing sense), this definitional exercise has to take place. And it is an exercise. This essay is in no way the definitive, comprehensive, and unassailable final answer. I hope, though, it is more than just the beginning. A secondary goal was to eliminate some misconceptions about effects. These arise, I believe, largely due to the lack of precision in terms. My final goal is to show why an effects-based approach is something worthwhile to consider, indeed to undertake. Part of my task is done: both *JV 2020* and *Global Vigilance, Reach & Power* advocate such an approach.

Appendix B: Lessons from Coalition Operations

In the movie Patton, the flamboyant American General is shown giving a speech where he uses the George Bernard Shaw quip that the "Americans and the British are two peoples separated by a common language." In many ways, that aphorism can be used to characterize coalition military operations.

These operations have been the norm throughout history and there is no reason to believe this will be any different in the future. However, some fundamental changes have taken place in the planning and execution of these highly intricate operations, especially in the 20th century and particularly given the military revolution wrought by the advent of airpower. During World War II operations can best be characterized as coordinated--better than merely cooperative--but not integrated. During DESERT STORM in 1990-1991 and Bosnia in 1994-1996, operations were better integrated but perhaps best described as still only synchronized. To become fully integrated, not only must the technical means military personnel use, but also the processes and most importantly, the context of operations must become truly shared. In other words, what is required at a minimum is a shared perspective.

As used here, cooperation is the loosest bonding between military forces of two (or more) nation-states in the planning, execution and assessment of operations. It may or may not involve efforts towards a similar end or use of similar means. Coordination, on the other hand, does require some conscious desire towards a common end or use of a common means. But it does not require any formal support/supporting arrangement. Synchronization is the next step towards combining efforts and does require specification of which military force will be supported by another in particular circumstances. However, military forces retain their individual identity. To be integrated at some level forces must be mixed and matched towards not only a common goal, but use common means and lose their individual identity. Supported and supporting arrangements are not required because these forces are essentially employed as one force, regardless of their national origin.

This essay is a short romp through three of the most significant coalition operations the United States (US), the United Kingdom (UK), and other major powers in Europe engaged in during the 20th century. The goal is to gain some insight into the problems that military personnel faced in coalition operations under conditions of great uncertainty and stress. Specifically, the interest here is how these problems affected the knowledge needs of military planners, both before operations commenced and during execution.

At best these are highlights, not history. It is anecdotal, not analytical. And the stories are not "who shot who" or "there I was" war stories. Space limitation is one consideration but the larger reason is the purpose. This is not meant to be a full-blown, comprehensive history, but insight. History teaches no lessons but people can profitably use the past to gain appreciation of the problems similar operations, now and in the future, might face. The case can be made, at least this essay so contends, that coalition operations place unique demands on the people, processes, technical means, and organizations charged with conducting these campaigns. Lacking a shared perspective worsens these demands.

Therefore, the first relevancy of this essay is to coalition operations in general. As Prussian General Von Moltke the Elder is credited with pointing out, a plan is nothing but planning is everything. This is because of the ad hoc nature of warfare. Coalition operations make warfare all that more challenging. Besides an intelligent adversary that reacts, military personnel engaged in coalition operations face a multitude of challenges in such areas as language, equipment, and perspective differences (Rice 1997). But somehow these must be overcome and melded into a single, coherent plan of action in order to get any mission done whether a humanitarian mission in the midst of the genocidal civil war in Rwanda or peacemaking operations in the Balkans. Furthermore some argue these missions are becoming more the norm since the end of the Cold War when the uneasy balance of terror between the nuclear superpowers tended to place limits on regional flare-ups. Events sparking response appear almost randomly. Near instantaneous worldwide communications fuel calls for an international response. Forces are mobilized and deployed quickly, often to areas in which they have had little to no experience or training. Partners are gained or cajoled. And somehow, in this increasingly information technology-driven world, the computers and communication devices these various forces use must all work together. The data, information, and one-day knowledge these machines voraciously consume must be available almost instantaneously. There is scant time to build or maintain data/knowledge bases. So the second major area of relevancy is for those who design and develop those technologies that support coalition operations.

While pure "knowledge" may be objective (that is, an outside party using the same methodology and data will arrive at the same conclusion), the type of knowledge the military people required in these operations was very contextually dependent. Furthermore, the most critical element in each context was how the various coalition partners viewed the mechanism for achieving specific military (or perhaps quasi-military) objectives. From these various perspectives, different targeting strategies were pursued. That, in turn, drove quite different information requirements.

Thus perhaps the most fundamental lesson one can take away from this brief survey is that any technology that purports to provide a knowledge base from which disparate coalition partners can draw from, must find away to wrap the data elements and information with context.

The next important lesson is related to how various planning organizations interfaced within themselves and between themselves. If one views these as formal (for example, specified supported/supporting arrangements) and informal organizational structural inter-faces/intra-faces, one is struck by the very ad hoc and fluid nature of these arrangements. Secondly, they are very personality dependent. Finally, they consist of a rather few number of key individuals. The lesson here is that technology must conform to these structures, not the other way around, to be efficient. Otherwise, much effort will be expended by the actors in seeking ways to work around the perceived "technology roadblock."

This essay looks at some key parts of the Combined Bomber Offensive waged by the US

Army Air Forces (USAAF) and the UK's Royal Air Force (RAF) against the Axis powers during World War II (WWII). The second case is the air campaign conducted against Iraq during DESERT STORM and the third is military operations in Bosnia-Herzegovina during 1994-1996.

The closing looks at some significant trends these examples highlight and examines their implications. Finally, the author, with much trepidation, offers some largely unformed ideas on where knowledge base development might move. The first development task, though, is a working definition of "knowledge."

Non-technical authors should be loath to hazard technical definitions, but since this essay seeks to shed some insight on these issues for those whose job it is to build technical items, this task seems essential. First of all, it must be stressed the use here of "knowledge" (and therefore "knowledge bases") does not conform to the varied on-going research efforts within the computer science fields. To do so would be counter-productive in that one would then be in a position of viewing past activities through the lens of current technologies instead of the other way round.

The framework used here is the "cognitive hierarchy" used in Naval Doctrine Publication (NDP) 6, Naval Command and Control. The first step is data, the bits and bytes gathered mainly by sensors in the form of raw signals and passed by telephone, radio, computer, etc. Data becomes information once it is collected and processed into usable form. "Knowledge results from analyzing, correlating, and fusing data that have been processed [i.e., is information] and evaluated as to their reliability, relevance, and importance." (NDP 6, 22; emphasis added) From knowledge, humans begin to see patterns and most importantly recognize what is not there—"the things that will forever remain unknown—and thus to identify the uncertainty we must deal with." (Ibid.) Understanding comes from applying judgment to that knowledge. "Judgment is a purely human skill, based on experience, expertise, and intuition." (Ibid, 23)

This framework is used in reverse by this essay. Based on the commander's "experience, expertise, and intuition" what knowledge (information, data) requirements can derived? Just as with any asset, knowledge is a finite (hence scarce) resource that comes at a cost. Assuming, therefore, an excess of data elements over knowledge required, what elements will be "processed"? Which analyzed, correlated and fused?

A final key element in this cognitive hierarchy--that becomes evident through the cases--is where the lines get drawn between technical and human involvement. Machines automatically do currently most data collection with little human involvement and increasingly that is true of the process of turning data into information. Knowledge processes on the other hand, are a mixed bag. Much fusion and correlation is done automatically but humans do most analysis. This, then, brings in context to the equation. The implications, then, are that knowledge bases must include the human context, "wrapped" around the information, to be useful. Next, since analysis contains a subjective element, other users of the knowledge base must be made aware of "what is verified information, what is opinion." Tied to this, of course, is the whole minefield of maintaining knowledge bases: finding and eliminating false "knowledge," purging "old"

knowledge, and the like. Tough challenges.[13]

It is this essay's hope that the short cases presented here will give some insight into those knowledge requirements commanders and their staffs have faced in the past. The first, and to some still the "Big One" of course was the Second World War.

RAF/USAAF Bombing of German Industry in WWII

Even before the shooting part of WWII started on 1 Sep 39 with the German invasion of Poland, airpower had already played a significant role. A significant reason British Prime Minister Neville Chamberlain acceded to German Chancellor Adolph Hitler's demands in the "Munich crisis" of fall 1938 was the fear of the German Air Force and the pitiful state of UK (and French) air forces. In the US this lesson did not go unheeded. In the largest defense budget ever submitted while the US was ostensibly at peace and isolationism ran strong, President Franklin Roosevelt devoted the bulk of his 1938 and 1939 submission to building the US Army Air Corps. (Overy 1980)

During World War I (WWI), airpower was at most a footnote to the trench warfare, and resulting carnage, of the Western Front. During WWII, however, airpower played a decisive role (some argue the decisive role) at strategic, operational, and tactical levels. Yet little in the two decades between those great wars could lead anyone to predict with any certainty what airpower could, or should, accomplish.

First of all, strategists of all stripes had more theory than experience to deal with. What was good about this state of affairs is many different ideas on the employment of airpower could be thought over, argued, written about, and touted as the answer to the overwhelming desire to avoid another costly, bloody war like the last. What was bad about this state, though, was the little opportunity to evaluate these various ideas that were at odds with each other in either real wars or controlled, honest, experimentation. The Spanish Civil War, for example, became the source of "data" used to support the claims of all sides of the airpower debate. Other "proofs" were mere showmanship, like the US Air Service's "bombing" of German warships that were of known location, dead in the water, and undefended.

Secondly, during those twenty years, airpower underwent rapid technological change. From the flimsy, vulnerable, short-range craft of WWI, the next war saw the advent of aircraft that could carry immense (for those days) payloads over great distances and deliver them with (again, for those days) startling accuracy. Airpower enthusiasts seized on these emerging capabilities (many while they were still on drawing boards) to argue

13 This does not, for course, exhaust all the theoretical (let alone technical) challenges. Differentiating meaning, intention, and understanding is crucial. This can be called the "vertical dimension" of knowledge with the data-to-understanding being the horizontal dimension. Briefly, meaning refers to the literal (e.g., lexicographical) language and comes mainly through usage. It is the "physical" message of language. Intention refers to that purpose the user wishes to achieve. It is the "message sent." It arises *a priori* of usage. Understanding comes from the receiver, not the sender, and therefore also arises from usage.

that airpower would allow fleets of bombers to cross relatively harmlessly over enemy ground forces and strike directly at the heart of an enemy's warmaking capability. Unfortunately, the pace of change was such that one, theorists could hardly keep up, and two, many theories were built in complete ignorance of technologies being developed that would severely hamper air operations. But perhaps most importantly, these various theories were based on different notions of how airpower would effect change in the enemy's behavior.

These different philosophies of mechanism between the USAAF and RAF resulted in vastly different targeting strategies that in turn required different knowledge needs. The focus here is on the strategic bombing campaign. There were also significant disagreements over what would now be regarded as the operational campaign, especially in the months immediately leading up to OVERLORD, the Allied invasion of Northwest France on 6 June 1944. Further, there were some significant differences between air and land planners over the most effective and efficient mechanism for achieving victory over Germany. What is "mechanism" and why is it important, especially for airpower

Mechanism, along with objectives, resources, center-of-gravity, and strategy, comprises one of the key elements in the conceptual plan for the employing a force. It answers why and how the strategy chosen will achieve the objective assigned using the resources available. It is vitally important when the cause and effect is indirect. Since many hold airpower is best employed in such an indirect mode, mechanism assumes great importance for airpower strategists. It is absolutely necessary to understand the relationship between objectives (or desired end state); the strategy developed to accomplish that end state; the resources required to make the strategy work; and mechanism. The other equally significant element, center-of-gravity analysis, will not be directly addressed in this essay nor will resources be given much attention.

For example, suppose a strategist after analyzing the enemy and their own strengths and weaknesses, and given a set of resources, determines the best approach for the use of airpower is to attack the enemy's re-supply network so that the ground offensive airpower is supporting will be successful. The mechanism here is: without adequate re-supply, enemy frontline forces will be weaker thus tilting the combat power ratio between our forces and theirs in our favor thus increasing the likelihood we will be successful. As will be shown, the different view of mechanism had significant impact on the planning and conduct of the campaign. They also, by extension, had significant impacts on the two air forces knowledge needs.

The British believed there was no one specific strategic target set more important than any other. Therefore the best use for airpower was to cause as high a general level of destruction as possible. This, they believed, would demoralize the German people, workers specifically, leading to a general decline in productivity, leading to a reduced level of armament output, which would limit the German forces' capability and ability to wage war.

Most of this belief came from how the RAF viewed their experiences in WWI. First, that war's air commander viewed the "moral effect" (more precisely, psychological) as much more important than the "material effect." Second, since the RAF lacked the resources to

disrupt or destroy any significant part of the German war economy, and those target sets were generally well-defended and bombing accuracy was dismal, attacking widely versus deeply preserved resources. Third, much 19th century military theory emphasized the importance of psychology in military operations. Fourth, their own national experience of German attacks against London which sparked the formation of the RAF led them to appreciate the disruptive effects of air attack on civilians in particular. Finally, airpower offered the means to spread effects broadly through and enemy state. Air Officer Commander-in-Chief of RAF Bomber Command, Sir Arthur "Bomber" Harris said his primary mission was to "make life intolerable for Germans in Germany" and his aim was "the destruction of German cities, the killing of German workers, and the disruption of civilized community life throughout Germany." (Biddle 1995, 124)

The Americans did not engage in strategic air attacks in WWI. In their studies after that war, they found the RAF attacks had no discernable affect on either the civilian population of Germany or its military forces. They also faulted the RAF for failing to systematically study the German war-making firms to see how one industry might depend on another. The second factor in the American theoretical evolution was the air arm's fight for independence from the US Army. They sought an independent mission to justify their call for independent command. They discovered this in strategic attack.

Like the RAF, the US Army Air Corps sought a strategy that was acceptable to the public and civilian politicians (Conrad 1993). The carnage of WWI led to calls for disarmament and outlawing war that meshed with the natural American desire for isolation from outside involvement. Strategic attack against German war industries offered a way to reduce what today is called collateral damage.

These different mechanism philosophies led naturally to different targeting objectives even though there was some intent and effort made to coordinate these two approaches. In 1940 as the RAF started bombing Germany in earnest, it initially started with daylight raids against industrial targets; especially those located in the Ruhr valley. Unfortunately due to inadequate bombers and the lack of fighter escort, those missions proved intolerably costly. In February 1942, just as the US Army Air Force (USAAF) was gearing up for its own unescorted, precision-bombing daylight operations from the UK, the RAF switched almost exclusively to attacks against urban areas of cities. The explicit object was to undermine morale by rendering "the German industrial population homeless, spiritless, and in so far as possible, dead" (Biddle 1995, 117)

Thus by the end of 1942, there were two different strategic bombing operations taking place over Germany largely from organizations based in the UK. The RAF targeted enemy will directly by attacking the population, at least the urban population, directly. The USAAF, on the other hand, targeted enemy capability directly by aiming at their ability to produce war material. Was one mechanism better? At the pivotal Casablanca Conference held in January 1943, both sides argued their case.

At stake was much more than airpower targeting strategies. Fundamentally the US and UK disagreed on the basic strategy for ending the war in Europe (Overy 1980). The Americans sought a more direct route by invading the continent as early as possible. This strategy, they believed, had the added benefit of cementing the Soviets to the alliance and

prevent a replay of WWI when they signed a separate peace with the Germans. The British favored a more indirect strategy of attacking Sicily and Italy first (the "soft underbelly of Europe" in Churchill's phrase) while continuing the blockade and strategic bombing of Germany. As so typical of coalition operations, the agreement was a compromise where each got what they sought. The US could continue daylight bombing operations and planning for a cross-channel invasion. The UK got a commitment to the Mediterranean strategy once North Africa was secured (which occurred in May 1943).

For the strategic bombing planners of RAF Bomber Command and USSAF Eighth Air Force, the outcome was the Combined Bomber Offensive Plan of May 1943. Six systems consisting of 76 targets were listed (Watts 1984, Appendix). Further, RAF-USSAF "combined efforts" were addressed but with this caveat: "This plan does not attempt to prescribe the major effort of the RAF Bomber Command. It simply recognizes the fact that when precision targets are bombed by the Eighth Air Force in daylight, the effort should be complemented and completed by RAF bombing attacks against the surrounding industrial area at night." (Ibid., emphasis added)

What was the actual outcome from either of these approaches is, still now, more than fifty years after the fact, very much in dispute. The one area the US Strategic Bombing Survey and British Bombing Survey Unit agreed on was the futility of "targeting civilian morale per se." (Biddle 1995, 126) On the other hand, the RAF attacks against German cities were undoubtedly destructive (Richards 1994). Furthermore, strategic bombing did cause Germany to divert substantial assets to protect their industrial sites and it did place an absolute maximum on how much war material they could produce (Overy 1995).

The most important lesson for those interested in knowledge base development is that drawing from past experiences is a potential minefield. "The wartime experience [WWI] had revealed the very steep, early portion of a marginal returns curve, so that those studying it tended to extrapolate linearly." (Biddle 1995, 98) Furthermore, as the post-WWI and post-WWII studies on the effect of airpower showed, analysts looking at the same data can arrive at fundamentally different conclusions. Closely related is the error the British made when they expected the German population to react against the bombing of cities in WWII liked their own population had done during WWI. This despite their experience with the German Blitz against London starting in September 1941 and continuing sporadically throughout most the war. They discounted any notion that populations might become used to air attack. Theorists of the 1920s and 1930s postulated that since air attacks ranging across the homeland meant there was no place to hide, and since civilians were "softer" than military forces, such attacks would at best cause populations to rise up against government and demand a stop or at worst, cause the population to become lethargic.

Finally, the convergence on the desire to attack as precisely as possible led to the need for precise information on not only location, but also composition and dependencies of one target to a whole host of other entities. This requirement would be magnified many fold in another great coalition operation involving the Americans and the British—the Persian Gulf War.

Desert STORM

When Iraq invaded Kuwait in early August 1990 and annexed it as the "19th Province," perhaps the last thing Saddam Hussein and US President George Bush imagined was that less than eight months later a coalition that included almost every country in the United Nations—including Arab—would hold together long enough to militarily expel Iraqi forces and liberate Kuwait. And while many countries did "contribute" to Iraq's defeat, the major players militarily were a few western and Arab nations. For the airpower forces, they were almost all members of the North Atlantic Treaty Organization (NATO) with the US and UK providing the bulk of forces. A first glance, one would suspect NATO would have eliminated the issues of divergence between the USAF and RAF over the best use airpower exhibited in WWII.

It is significant that DESERT STORM was a coalition operation and not an alliance one. The main difference is that coalitions tend to be short-lived and exist only for a given situation. Alliances are formalized through international treaties and exist over long periods of time, even when the original conditions that led to the formation of the alliance no longer exist. The most significant aspect of this difference for this essay is alliances allow the means and time to develop shared perspectives between its members whereas coalitions do not. For example, NATO had at least developed rudimentary common procedures over a generation of cooperation, but since this was not a NATO operation most of those procedures did not apply. Other considerations also played an important role. First, while some partners were not completely former foes, at least they were not old buddies (e.g., Egypt, Syria). Second, there were significant differences in equipment levels, capabilities and the skills between many of the partners (Atkinson 1993, 152-155).

Airpower matured immensely since WWII, but not all parts matured to the same degree. Platforms undoubtedly matured the most. British and American planners of the early 1940's could not dream of the capabilities today's planners take for granted. Stealth, sensors, range, accuracy (in both navigation and weapons delivery) and electronic warfare (EW) have shifted the balance between the offensive and defensive capabilities of airpower. While Stanley Baldwin could tell the House of Commons in 1930 that the "bombers will always get through" even though there was little empirical evidence of that, today it is a truism, at least for the western air forces. Furthermore it is the combination of these capabilities that is truly impressive. F-117 Nighthawk aircraft could fly undetected hundreds of miles to a precise building in a major metropolitan area surrounded by an advanced air defense system, then use on-board infrared sensors to precisely guide a weapon via a laser beam down an airshaft. Could that happen every time? No. Did it happen more often than not? Yes.

Weapons probably matured the second most. In DESERT STORM, precision guided munitions (PGMs) were the star of the show even though they constituted only a fraction (<5%) of all the weapons employed. While laser-guided bombs (LGBs) were the bulk of PGMs employed, AGM-65 Maverick air-to-surface anti-tank missiles, GBU-15 glide bombs, and HARMs (High Speed Anti-Radiation Missiles) were also prominently, and effectively, used. The significance of these weapons is based on the concept of "economy of force." This principle of war states that only the minimum required force should be used so as to preserve combat power for other operations. While not as efficient as "one target-one bomb," PGMs did allow a wider range of targets to be struck simultaneously

with the same degree of assured damage as would other wise be the case. This also enhances the survivability of the delivering aircraft.

Command and control (C2) probably matured the least since WWII. The technology generally kept pace though there were some key exceptions such as digital communications and computer assistance for planners. However, the operational art skills did not. Generally this is blamed on the Cold War where the almost exclusive focus on Europe and Korea had two dilatory effects. First, since operations there had been determined for so long, there was no need to plan afresh. Surely changes to plans were made over time, but they were largely incremental, not a de novo start as was required by the Iraqi invasion. Second, both anticipated contingencies—most especially in Europe—were tied up with the use of nuclear weapons and the superpower confrontation between the US and the Soviet Union. If one truly believed a Warsaw Pact invasion of Central Europe would become a general nuclear exchange within a few days of weeks, planners concentrated mainly on preventing that occurrence rather than winning a conventional war, though there were some dissenters (e.g., Mearsheimer 1982). Of course the major causality of the lost operational art was the failure to grow a new generation of operational-level planners who understood strategy and who could think through the mechanisms various strategy options offered.

The major difference over what mechanism would most likely achieve DESERT STORM's objectives was between the air and land component planners rather than between the various air forces. This, of course, was not new. There was a significant difference of opinion between air and land planners during WWII. When Iraq invaded, Commander-in-Chief US Central Command (CINCUSCENTCOM or "CINCCENT" for short) US Army General H. Norman Schwarzkopf knew he had a problem. There was no in-theater US forces. With the huge distances involved, the quickest capability he could bring to bear was airpower. Therefore, within 48 hours of the invasion, Schwarzkopf and his air commander, US Air Force Lieutenant General Charles A. Horner briefed President Bush on a rough air campaign. The strategy was classic: gain air superiority over the battlefield then attack Iraqi resupply efforts. The mechanism: by denying supply, Iraqi ground forces will be unable to sustain combat operations and will be forced to retreat or, if they do not, be vulnerable to a counter-offensive. In essence, this became the genesis of what was known as the "TAC plan."

Within 96 hours of the invasion, another plan, radically different from the TAC plan, began taking shape in the basement of the Pentagon under the direction of US Air Force Colonel John A. Warden, III. The essence of this plan was to attack the Iraqi centers-of-gravity (COGs)[14] that would have the most immediate impact on Iraqi leadership. His

14 Defined by the US DOD Dictionary as "those characteristics, capabilities, or localities from which a military force derives its freedom of action, physical strength or will to fight." Note the term "military force." The great Prussian theorist, Carl von Clausewitz used a more expansive phrase to include all of the enemy state, not just its military forces. Again this highlights the different perspectives: does one wage war against the enemy nation-state or only against its military forces? The Warden plan was premised on the former; the TAC plan on the latter.

mechanism was as straightforward as Horner's was: with his COGs destroyed, an enemy would be forced to give up—or lose power—because they would no longer have the capacity to continue (Reynolds 1995). Much of the confusion, and mythology, over "Warden's plan versus the TAC plan" arises from the misunderstanding of the original purposes of those two competing plans. The TAC plan was to stop Iraqi forces if they continued into Saudi Arabia. The Warden plan, known subsequently as INSTANT THUNDER was a retaliation plan in Schwarzkopf's mind, at least initially (Gordon and Trainor 1995, 76; Schwarzkopf 1992, 313).

No clearer image arises of this essay's thesis on the importance of shared perspective, particularly in coalition operations, than the different perspectives over the land campaign both between the US Army and US Marine Corps, and between the US and its Arab coalition partners. The commander of US Marine forces in theater sought a frontal attack into Kuwait than even the Marine Commandant found ill advised. US Army planners, on the other hand, eventually settled for the famous "Left Hook" that sought to avoid direct battle until all odds were in the coalition favor. Finally, Syria became reluctant to commit its army to the land offensive forcing CENTCOM planners to place them in a reserve role. This in turn led to some backsliding on the part of the Egyptian forces again forcing planners to alter the concept so the Egyptians could attack 24 hours after the initial wave (Schwarzkopf 1992).

These differing perspectives, especially over mechanism, played out specifically when it came to targeting. The first disagreement occurred when Warden briefed Schwarzkopf on the INSTANT THUNDER plan on 17 Aug 90 though it had been presaged when Warden briefed the Chairman of the US Joint Chiefs of Staff, US Army General Colin Powell, on 11 August. The first question, which also was raised by TAC planners, was if Iraqi ground forces moved against Saudi Arabia from their positions in Kuwait? Warden's initial plan dealt only with strategic targets and operationally, only with Iraqi air defenses. The second question, and the one raised specifically by Powell, was whether even if Hussein acceded to demands due to the Warden's plan (in other words, accepting as given the unstated mechanism of INSTANT THUNDER), would not leaving his (assumed quite powerful) ground forces intact just leave a further mess to deal with sometime later?

At root, this was the fault line. And there were several dimensions to the debate. The one detailed here deals with how the context of the situation shaped the perspectives of the various sides and how, in turn, this precluded the emergence of a shared perspective despite commonality of language and concept. Not too simply put, the Warden plan from concept to targeting was concerned with the best application of airpower while the TAC plan from concept to targeting was concerned with the best manner of accomplishing their mission. In the later light it seems clear that despite two one-to-one presentations of the Warden plan between himself and Schwarzkopf within an eight day period, both men saw INSTANT THUNDER from completely different points-of-view (Gordon and Trainor 1995, 90). For Warden, it was an integrated war-winning plan. For the CINC, it was a "Chinese menu" of retaliatory strike options.[15]

15 Compare, for instance, the account in Reynolds (1995, 103-110) with that in

This divergence of perspective increases as the planning shifted from the Pentagon and USCENTCOM's Florida headquarters to Saudi Arabia. As the Warden plan and TAC plan get merged, the major source of divergence occurs between the land component planners and the air component planners. Again the basic first principle disagreement lies with mechanism. Reflecting traditional ground forces' perspective, land component planners viewed the destruction of Iraqi ground forces as the means to victory: a defeated army meant an undefended nation that would cause Iraqi leadership to accede to the coalition demands. This belief, then, led those planners to seek the best use of airpower to support ground power in their quest of defeating the Iraqi forces. Air planners, on the other hand, believed that by attacking a broad set of Iraqi COGs, that the Iraqi leadership would be paralyzed (Hallion 1992, 151).

Like every other military operation, DESERT STORM offers up no clear, crisp evidence upon which one can base any conclusive argument over which position was right. However, on balance post-war official reports lend more credence to the air planner's view than the ground planner's view (US Department of Defense 1992; US Air Force 1993). Not that "airpower could win all by itself" but rather that a successful air campaign is a necessary condition for any successful land (or naval) campaign. Of course this lesson is a repeat of ones learned as long ago as World War II and validated in every major military conflict since. What the Gulf War did not resolve, however, is what type of air campaign is most effective. Since neither the Warden plan nor the TAC plan was executed in their pure form, it is an unanswerable question. And given the axiom that "every war is unique," any purported answer would be meaningless anyway. What are of some use, however, are the lessons one might take away on the processes, especially in planning.

Clearly the singular achievement of planning in DESERT STORM was the attempt to centralize all planning into a few responsible organizations. The JFACC (US Air Force Lieutenant General Chuck Horner) generally gets the most attention but early on the CINC (US Army General H. Norman Schwarzkopf) attempted the same trick for the ground campaign. The second achievement was planning that came "top down" in that attacks were planned against targets because of the effect the commander desired, not simply because it was "there." One wishes to exercise caution here. This is not to say that previous campaigns did not attempt this linkage. Rather it was due to the integration of the campaign—both organizationally and intellectually—that facilitated the linkage. Finally, notwithstanding the following remarks, coalition issues were in the forefront of strategic and operational level planners from the very beginning. Furthermore, the JFACC concept proved adept at incorporating coalition considerations. Despite their focus on Joint operations, Winnefeld and Johnson (1993) acknowledged that in DESERT

Schwarzkopf (1992, 318-321) of the 17 Aug 90 Warden brief to CINCCENT and his staff. Even more telling is this in Reynolds describing Warden's presentation of INSTANT THUNDER to General Horner in Riyadh, Saudi Arabia: "It was curious that these two men [Warden and Horner] were so far apart intellectually and emotionally. Both wore fight suits, both were fighter pilots, and both had done combat tours in Vietnam…. Yet, they seemed to have no common lineage—nothing upon which to build mutual trust or confidence." (1995, 122)

STORM allied forces “represented one more layer of complexity; JFACC tried to broker national and service interests and develop [an air campaign] that fulfilled both his responsibilities and those external requirements.” (122)

Examples of bad planning, unfortunately, are numerous and easy to find. Fortunately, they generally occurred before 17 Jan 91, and not after. The most significant was the plethora of small, independent, and unconnected “special planning groups.” The US Secretary of Defense had one (the “Western Excursion”). The Chairman of the US Joint Chiefs of Staff had one. The CINC had one, possible two. The JFACC had one (the “Black Hole”) until December 1990. While all were well intentioned, one can easily see the potential for mass confusion had Iraqi forces attacked during the November-December “second deployment.” None worked together and most did not include coalition members to any great extent (e.g., Atkinson 1993, 108). In fact, General Horner explicitly decided that until the plan was fairly robust, no coalition planners would be involved (Reynolds 1995, 127). This was important. When coalition partners were brought onto the planning teams, it was clear they had meaningful differences with the Americans, especially over Iraqi intentions (Gordon and Trainor 1995, 74).

In the last case examined here, coalition operations in Bosnia, this problem of multiple, non-connected planning efforts was absent. Why this was so, however, is not clear. For one thing, the time from the Iraqi invasion to the time the overall theater campaign plan was done to almost executable detail was very short, less than three months. In Bosnia, planners worked up an evolutionary set of plans over three years.

Bosnia

In July 1992, NATO deployed naval forces to the Adriatic to monitor shipping to the former Yugoslavian republics. The United Nations had imposed an embargo the fall before and placed peacekeepers in Croatia the previous spring. Those “Blue Berets” moved into Bosnia-Herzegovina that September and NATO air patrols, sent to enforce a UN resolution banning all flights not approved by the UN peacekeeping forces, started on 16 October 1992. This operation, DENY FLIGHT, started the sequence of events that led in August 1995 to DELIBERATE FORCE, the direct military action against Bosnian Serb forces designed to force them to the negotiation table. In this it was successful. This series of operations resulted in many “firsts” for NATO. It was the first real military campaign it ever waged in its 40+ years of existence. It was the first “out-of-area” operation. This means military operations conducted against an adversary that did not directly threaten a member. It should be recalled that during the Gulf War, NATO took no offensive action, and defensive preparations of questionable value, even though the enemy state was right on the border of a member state (Turkey). Finally, the Balkans operations were considered “operations-other-than-war” (OOTW). These missions include operations such as humanitarian relief, peacekeeping, peace enforcement and peace making. They were never part of NATO’s original intent.

The key point of this section is to examine the difficulty of assessing context in these areas. Since context is such a critical part of constructing a knowledge base, understanding where these pitfalls lie becomes of utmost importance.

These OOTW missions cover a wide range of activities that previously went by such names as guerilla warfare, foreign internal defense, counter-insurgency, nation-building and so forth. Modern usage can be misleading. Generally these missions are listed as humanitarian relief, peacekeeping, peace enforcement, and peace making. Only the last three concern us here. The first point to be made is they are not along some "continuum." Second, peacekeeping requires strict neutrality between the peacekeeping force and the various sides to the conflict. Third, ostensibly there is no fighting for a peacekeeping force whereas peacemakers or enforcers at least must anticipate fighting if not, as in Bosnia, actually starting military operations.

Historically, militaries viewed these quasi-constabulary missions with some disdain. While there is a whole host of differences, four major considerations shape the armed forces' view of these missions. First, these missions are not so clear-cut as "normal" military missions. Nowhere is that most evident than in the lack of a clearly discernable "end state": that state, or set of conditions, the military commander seeks to achieve so that other instruments of national power (normally political-diplomatic) can take over. Second, given the "glue" of the Cold War that seemed to keep many regional conflicts in check (or at least the major power's response to those conflicts), these missions can occur almost anywhere: humanitarian relief in the Caucasus and central Africa, peace-enforcement and peace-making in the Balkans, show-of-force in the Taiwanese Strait. Tied closely with this, the third major change is the uncertainty of partners in any given operation. Further, these partners include significant numbers of "non-military" organizations such as the International Red Cross, religious relief agencies, and others. Finally, due to the political sensitivities of these missions, the rules-of-engagement (ROE) tend to be extensive and quite restrictive. This, in turn, leads to a shift in the traditional balance of "centralized command-decentralized execution" to more centralization of both.

This inversion of traditional military norms is mirrored in the changes between the national instruments of power as to their application and perceived effectiveness. In conventional conflicts, military force is normally seen as a blunt instrument whereas the political instrument is seen as the more discriminating. However, with the advent of precision weapons and delivery systems, military forces are seen as highly discriminatory. A good example of this was the planned use of airpower to protect individual "safe areas" around towns and villages in Bosnia. On the other hand, two examples highlight the use (or threat) of military operations by diplomats as blunt means to force Bosnian Serb compliance.

Before DELIBERATE FORCE commenced, US Assistant Secretary of State Richard Holbrooke, also the lead negotiator, went on a US news program and "threatened a six-to-twelve month campaign of air strikes against the Bosnian Serbs to level the playing field" and force the Serbs to the negotiation table (Mueller 1998, sec. 1-13). Unfortunately, Holbrooke's objective was never one that NATO had agreed to. In fact, protecting the safe areas remained the overt goal of DELIBERATE FORCE. Further, unstated but essential political objectives is not unique to OOTW. Yet, the presence of these, when held by only some members of a coalition, greatly complicates military operations. As will be shown below, this became an important matter during execution of

the air campaign.

The second instance occurred during the air operation itself. During planning, a deliberate pause was built in so that the Bosnian Serbs could assess for themselves the damage to their forces and supporting infrastructure. Yugoslavian President Slobodan Milosevic hoped the pause would make it more difficult politically for NATO to resume bombing. However, when the attacks resumed on 5 September, at the insistence of the diplomats, Milosevic's last hopes were dashed and soon after he agreed to terms. "Mr. [Christopher] Hill [Holbrooke's assistant in the negotiations] did not need up-to-the-minute bomb damage assessments to tell him the effectiveness of the air campaign; he could see the impact on President Milosevic's face." (McLaughlin 1998, sec. 7-2) However, just as important as the air strikes were the Croatian land offensive (Operation STORM) that started on 3 August 1995—weeks before the air campaign—perhaps was just as decisive. What this points up is the blurred strategic-operational-tactical environment so typical of OOTW.

Other examples of this blurring is determining who is the "good guy" and who is the "bad guy"; and who is in charge (and when). Too often the issue was starkly put as "the Serbs are the bad guys and the Muslims are the good guys" but the reality was more muddled. For example, the proximate cause of the fighting in Bosnia can be traced to the March 1992 vote by Bosnian Muslims (44% of the 1991 population in Bosnia) and Bosnian Croats (18%) to succeed from Yugoslavia. This struck fear in the Bosnian Serbs (31% of the population) who feared they would be persecuted as their brethren had been in Croatia when it left the federation (along with Slovenia) in the summer of 1991.

The issue of "who's in charge" though is of more immediate import to this essay since that will have great influence on what objectives will be pursued in what manner and when, which drives knowledge requirements of targeting and the like. For most of the DENY FLIGHT/DELIBERATE FORCE operation the answer was two: the UN and NATO. This was formalized in the "dual key" arrangement. Basically this meant that both organizations had to approve the use of force. Practically, it meant force could hardly be used in a reactive manner since approval times could stretch for hours, hardly useful when friendly forces requested immediate assistance. Fundamental to this arrangement was the different perspective and philosophies exhibited by the UN and NATO.

The first point to emphasize is this disagreement did not arise due to the differing outlook of diplomats versus military commanders. On the contrary, French Lieutenant General Bernard Janvier, the UN Protection Force (UNPROFOR) commander had led French ground forces in DESERT STORM. His deputy, British Lieutenant General Rupert Smith had also been a division commander in that war. Interestingly enough, it was on the NATO side where one finds little recent experience in major military operations from the Supreme Allied Commander Europe US Army General George Joulwan down until one reaches US Air Force Major General Hal Hornburg, the Director of the Combined Air Operations Center (CAOC) at Vicenza, Italy. Secondly, as has already been alluded to, there was a significant difference between the military commanders and the diplomats. This prompted Ambassador Holbrooke to remark, "the same people who had doubts about it [the bombing campaign] ran it so brilliantly." (McLaughlin 1998, sec. 7-2)

Janvier agreed Bosnian Serb forces needed to be attacked but he wanted a close reign so they would feel "pain but not death." As the person in charge of the peacekeeping forces on the ground in Bosnia, and who faced the humiliating task of freeing those of his forces who had been taken hostage by the Bosnian Serbs, one can see his perspective. (Conversino 1998, sec. 5-2) US Navy Admiral Leighton W. "Snuffy" Smith, Commander-in-Chief of Allied Forces Southern Europe (CINCAFSOUTH) wanted to attack logistics and command and control (C2) facilities. As pointed out, the NATO objective was protection of the safe areas. Admiral Smith believed the heavy weapons posed the greatest threat to those areas but were exceedingly difficult to find let alone attack. Hence he felt attacking the supply and C2 nets offered the best strategy. There is a key point here. Janvier's mission was one of peacekeeping whereas Admiral Smith's was one of peace enforcement. NATO air planners, though, encouraged senior leadership, and especially in the UN, to take a more expansive view of the air campaign. They believed a more 'strategic" orientation would more quickly cause all levels of Serbian leadership (both within Bosnia and in Belgrade) to acquiesce to UN and NATO demands. In other words, they argued for a broader peace-making role. Finally, air planners insisted on a comprehensive suppression of air defense (SEAD) operation in order to minimize threats to allied aircraft and expand the area for freedom of air maneuver.

Thus four sets of mechanisms can be identified, not all complementary. First was UNPROFOR. Janvier wanted to protect the safe areas and his forces on the ground in the same way: minimal force applied under maximum control. CINCAFSOUTH too wanted to protect the safe areas but also to reduce the combat power of the Bosnian Serb Army (BSA) so they would be less a threat in the future. Hence his mechanism followed that of classic interdiction: reduce the effectiveness of military forces indirectly by reducing their supplies and the ability of commanders to orchestrate their forces over large areas. The wider view of the campaign (reflected in so-called "zones of action"; ZOA) essentially viewed all of Bosnia as two "safe areas," one in the southeast and one in the northeast. According to Chris Campbell (1998), the acceptance of this by the UN in July 1995 was "a significant step in the direction of a strategic air campaign" because the "UN finally understood that activities occurring outside the safe areas … had a significant impact on more than one safe area…" (sec. 4-9) Finally, the SEAD options sought two complementary mechanisms. One, the increased freedom of operations would make follow-on air strikes not only less dangerous but also more unpredictable. Two, the belief was the BSA air defense structure formed a significant part of their combat power. In summary, the Janvier mechanism could complement the CINCAFSOUTH mechanism but was at odds with the ZOA and SEAD mechanisms. Either the ZOA or SEAD ones could complement Admiral Smith's mechanism while air planners believed those two highly complementary. How successful was DENY FLIGHT or DELIBERATE FORCE?

The air policing operation was doomed from the start by three constraints. First, the decision was made quite early to exclude helicopter flights from the ban. One reason was they are terribly unpredictable as to origin and destination. Another was the short duration of most of those flights. Third was the detection difficulty, especially in such mountainous terrain. But perhaps most damaging was the fear if NATO shot one down, "its owners would rapidly fabricate evidence that it had been on a humanitarian mission loaded with noncombatants, potentially causing a public relations disaster for NATO."

(Mueller 1998, sec. 1-9) The next constraint was the severe limitation placed on the use of NATO force. "Denying" aircraft flights is a negative aim that does little to prevent BSA forces from over running safe areas with ground forces. NATO recognized this very early, authorizing planning for the offensive use of airpower as early as August 1993. But events in May 1995 showed how difficult these operations were. In response to BSA shelling of Sarajevo, the UN requested retaliatory air strikes that were duly carried out. These proved counterproductive when, as they had in similar occasions before, the BSA took 370 UN peacekeepers hostage and used them as "human shields" around suspected NATO targets (and on TV screens worldwide). NATO and the UN had no choice but to cease those attacks. The final constraint was the "dual key" arrangement outlined earlier. As a practical matter it gave the UN an absolute veto over NATO operations. That proved crucial in DELIBERATE FORCE.

The offensive air operations that commenced in the early hours of 30 Aug 95 are seen by many as an overwhelming success. And in broad outline they were. The goals were to get the Bosnian Serbs and their Yugoslavian allies to the negotiation table, to secure the safe areas from further BSA incursions, and to further reduce BSA combat power so as to "level the playing field" vis a vis the Bosnian Muslims. It is in some of the nuances that assessment gets more problematic. First, the UN directed what was to be a 24-hour pause in operations.[16] This was contentious among the key players. Ambassador Holbrooke, Admiral Smith, and General Janvier all initially supported the pause. NATO Secretary General Willy Claes, General Joulwan and air planners who saw the pause as a throwback to the "on-again, off-again bad old days" of Vietnam, opposed giving up any initiative.

The other issue always under the immediate surface was the "Americanization" of the Bosnia operation. As Owen (1998b) points out, arguably this underlay the "dual key" arrangement. If this arrangement was needed so as to prevent an "irresponsible or ill-advised" attack, who would mount such a thing? The UN? No, their forces were lightly armed peacekeepers. NATO? Not if all (then) sixteen nations had to agree. No, the fear was the American "cowboys" would use the cloak of NATO to pursue their own aims and who, to European eyes at least, seemed too willing to draw blood. This became a greater concern when the NATO uniformed command structure was seen as "pure US" from SACEUR General Joulwan down to the wing commander at Aviano Air Base, Italy and the USS Theodore Roosevelt aircraft carrier in the Adriatic. The bulk of air attacks would be launched from these two locations. By contrast, the UN side was all "non-US" from the Secretary General down to the UNPROFOR commander and his deputy. From this starting point, three lessons seem clear.

The first lesson deals with the Bosnian air operation as a coalition event. Here the record is mixed. At the theater and above level, it was clearly a coalition operation. Claes, Joulwan, both Smiths, Janvier and others worked closely and constantly together and, despite their differing organizational perspectives, forged an effective and workable

16 Due to weather and other unforeseen events, the pause actually lasted 1-5 Sep 95. There was an additional pause that started on 14 Sep. Soon after, the Bosnian Serbs agreed to terms.

shared perspective. Unfortunately, at the operational planning level, things were seen differently. US Air Force Colonel Douglas Richardson, Hornburg's deputy for current operations, believed the operation resulted in closer NATO ties between the eight NATO countries that flew. The CAOC was nominally under the command of Italian Air Force General Andrea Fornasiero but he apparently recognized the dominant role played by the Americans. Further, other non-US NATO officers saw DELIBERATE FORCE as a US-run operation with just a veneer of participation by others so it could be portrayed as a NATO operation (Conversino 1998).

The second lesson is that technology dictated the role countries could play at both the operational and tactical levels. At the tactical level two considerations drove the choice of weapons and platforms: the desire to limit collateral damage and national restrictions. The first consideration mandated the use of precision-guided munitions (PGMs) to a maximum amount possible. However, neither the Dutch nor the Italian aircraft that participated possessed PGM capability. The second consideration also limited the planner's use of certain platforms. Both the German and Turkish governments proscribed what missions their aircraft could participate in regardless of the capabilities of either their aircraft or their aircrews. The upshot of all this is the Americans ended up flying two-thirds of all the sorties and dropped over 85% of all PGMs. At the operational level, interoperability was the main consideration. NATO command centers were never known as state-of-the-art facilities and this was even truer of the CAOC in Vicenza. Hence as operations heated up, almost all the command, control, communications, computer, intelligence, surveillance, and reconnaissance (C4ISR) capability came from the US. Further, NATO planners, schooled in ways of countering a massive Warsaw Pact invasion of NATO's Central Front, were ill-prepared to plan, conduct and assess OOTW mission conducted out-of-area in the Southern Region. Thus many US individuals and organizations such as the 32nd Air Operations Group, Checkmate, and even Colonel Dave Deptula of DESERT STORM "Black Hole" fame were sent to assist. That these were "US only" efforts only added to the perception that Bosnia was mainly an American operation. Furthermore, since these individuals and teams came and went, plus the fact that most of the US folks in the CAOC were there for short tours of duty, mitigated much sense of unit cohesion.

Major Mark C. McLaughlin wrote: "Although the CAOC BDA [battle damage assessment] team knew the location of each DMPI [desired mean point of impact; where the bomb's supposed to hit], or aim point, and could determine the physical damage to the targets, it was difficult to link the apparent physical damage to functional damage and to the theater objective of compelling the Bosnian Serbs to withdraw equipment from the TEZ [total exclusion zone]." (McLaughlin 1998b, sec. 6-4) This third lesson gets re-learned time and again: there is scarce any way to connect what damage has (or has not) been done to a physical entity and whether or not the theater commander's objective has been accomplished. This, in the past and evident here in both the strategic bombing of Germany in WWII and DESERT STORM, has caused planners to apply overwhelming force against lots of targets in the belief that something will ultimately give. However as Bosnia shows, in OOTW that "massive force" mechanism is seldom an option. Bosnia also showed that NATO BDA doctrine, like US BDA doctrine and NATO campaign planning doctrine, was non-existent. Absent any such concepts, it is little wonder at the

lack of technology available to assist in any of these endeavors whether in a US-only let alone a coalition environment.

What Have We Learned

There seem some discernable trends through these case studies in terms of coalition coupling, partner hierarchy, and doctrinal interoperability. The first area looks at coupling of organizational infrastructure interfaces along a spectrum from cooperation, through coordination, then synchronization, and finally integration (Kirin 1996). The UK-US experience in WWII was largely cooperative and with some effort (and much lip service) to coordination. They did not even have a common command center. In DESERT STORM, largely due to the shared NATO experience of the major players, air efforts were fully synchronized and arguably integrated in the execution stage only. The few "outliers" were the difference of opinion between the US Air Force and US Marines, the political limitations faced by the Royal Canadian Air Force, and the presence of many (albeit small) coalition forces which were, if not former enemies, and least former adversaries. DENY FLIGHT/DELIBERATE FORCE, on the other hand, were fully integrated operations with some caveat on what is meant by integration. The main cause of this was that these operations were specific NATO operations (the first, it must be recalled, to be real "shooting" events plus the first ever voyage into so-called "out-of-area" operations). The caveat is the political restrictions on operations. For some outside observers, this might have seemed intrusive and an undue interference with "military" operations. On the contrary, the very history of the alliance pointed the way for such reservations. It was just that Bosnia proved the first real test that made the ever-present reality more visible.

Partner hierarchy and doctrine interoperability is closely tied. In 1942, the UK was clearly the senior partner in the alliance initially. Just as clearly, before WWII there were very limited cases where air forces actually trained or coordinated doctrine. Worsening this of course was the fact that the RAF had been flying combat missions for over two years; had initially pursued then abandoned daylight attacks against German industry; before the Americans arrived. In the Gulf War and again in the Balkans, the shared NATO experience, even as weak as it was, gave the partners what Sir Michael Howard calls "a standard to deviate from." Likewise, while there is little doubt the US dominated the planning (and provided the bulk of the air forces) for DESERT STORM and DENY FLIGHT/DELIBERATE FORCE, the nature of the operations, especially Bosnia, mitigated the American's ability to have things totally their way.

These trends so briefly noted have several implications for knowledge bases (KB). Most obvious is that integrated operations require integrated KB. The challenge here is the fundamental challenge of coalition operations: How can one build a KB prompter hoc without knowing who the playing partners are, where (and when) the missions might take place, and what sort of missions might be required (and why)? Second, the senior partner will tend to be the "owner" of the KB especially if they have been engaged in operations before the other partners come on board. This was not just true in WWII, it was also true when JOINT ENDEAVOR, a peacekeeping endeavor, replaced earlier operations in Bosnia. The Russians, and others, joined an on-going operation. Unless one envisions a "one-world" KB, this might prove the most difficult problem. Finally, the doctrinal

interoperability is most likely among formally aligned partners and, if the NATO experience is any guide, even then it is a thin veneer. As pointed out, context is crucial and is a major discriminator between what this author's image of a KB is versus a "souped up" (e.g., faster, smarter retrieval means, etc.) relational database. Lest this sound too pessimistic, let the essay close with some thoughts on what might be accomplished that would add real value to military operations.

Where Do We Need to Go?

There are some key facts one must keep in the forefront when contemplating building or using knowledge bases for military operations within a coalition environment:

• Warfare is more art than science.

• Art is more intra-cultural than inter-culture, even more so than language.

• Culture is context-specific.

• History is the entire context we have about the past. In individual terms, history means experience, the source of expertise.

• Context is more science than art but human perspective of context is more art than science.

• Finally, airpower is more science than art especially compared to land power.

Therefore, any KB problem must seek to answer how context can be included along with the data-turned-information that marks the current state-of-the-art of relational database systems. However, that is not the only problem a KB developer faces. Two others are multi-level security (MLS) concerns and interoperability. Of course, these are development problems not necessarily research ones but some appreciation of these is necessary in order to tackle the real problem of KB: capturing different perspectives of the same context.

In one sense MLS is the easiest problem to solve. Basically it is a policy issue. Unfortunately, once the policy issued is one requiring discrimination of access to certain knowledge or certain knowledge at specified times, it becomes a technology issue. The first barrier to overcome with interoperability is understanding that it need not mean "same" or "Buy American." Otherwise, the commonplace wisdom is that commercial markets will sort out the standards issue so that machines can interoperate together. From one sense this is quite right. Electronic commerce, to become the "wave of the future" so many predict, does require disparate machines to work together. Furthermore, e-commerce also requires levels of encryption some believe more than exceeds military forces' requirements for MLS. Undoubtedly that is true for almost all applications (nuclear, chemical and biological weapons come to mind as exceptions) which only highlights the basic policy nature of the MLS issue.

Which brings us to the tough question for knowledge developers: can the different perspectives which shape knowledge for various groupings be captured in such a way

that a shared, though not common, perspective can be shown? For sure efforts to code primitive terms into machine-readable language and grammar are important first steps. But as this brief run through past operations seems to demonstrate, that necessary condition is not nearly sufficient to be called a shared representation.

The classic story over how different context lead to different perspectives despite common language is when three people from different military services are told to "secure that building." The marine implants mines and machine gun nests with interlocking fields of fire and sternly reports "Sir, the building is secured." The soldier checks every door to make sure its locked and turns on the alarm systems and dutifully reports "Sir, the building is secured." The airmen takes out a 30 year lease at favorable terms with an option to buy and proudly reports "Sir, the building is secured." George Bernard Shaw would understand.

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Appendix C: Operation Deny Force (ODF)

Introduction. This paper outlines a common challenge problem that highlights technologies developed by AFRL/IF. The scenario, Operation DENY FORCE, is completely notional but reflects the types of mission and circumstances US military forces faced in the 1990s. It is set in 2010 and makes use of a Global Strike Task Force (GSTF) and Aerospace Expeditionary Task Force (AETF), both supported by a Theater Air Control System consisting of a Block 30 Aerospace Operations Center (CAOC), Multi-sensor Constellation Command & Control Aircraft (MC2A), and Global Hawk (GH) unmanned aerial vehicles.

Purpose. The purpose of the common challenge problem (CCP) is to show, through the use of a campaign-to-engagement level scenario, how IPB (Intelligence Preparation of the Battlespace), and EBO (Effects-based Operations) tools work together to help achieve a Joint Force Commander's (JFC) intent quickly, decisively and using fewer resources than current practice. These tools enable an effects-based approach. The CCP is designed to support spiral development of the toolsets. The current configuration of the CCP supports planned research and development efforts over the 2001-2002 period.

Method. The CCP follows a normal course of events from a crisis through execution and assessment of a campaign plan. First, the crisis is developed by following the steps found in the Crisis Action Planning (CAP) procedures as modified by the Joint Forces Command (JFCOM) experimental Joint Force Headquarters (JFHQ) concept of employment. The output of the JFHQ process is an Effects Tasking Order (ETO). An ETO contains the JFC's selected course-of-action (COA) and Commander's Intent. For the CCP, this part is scripted.

The ETO forms the basis for detailed planning by the Joint Force Air Component Commander (JFACC) and staff. This ETO specifically tasks component commanders to develop two branch plans: one covering Time Critical Targets (TCT) and the other handling Combat Search and Rescue (CSAR). CSAR closely approximates a "tanks under trees" (TUT) or cover, concealment and deception (CCD) problem. From receipt of the JFC's Commander's Intent and COA, the CCP goes "live" even though much of the inputs are scripted and many of the tools are not fully integrated. The outputs of the JFACC's detailed planning process are Dynamic Aerospace Execution Orders (DAEO) that goes to the tactical units, such as a GSTF or AETF, for execution. Between receipt of Commander's Intent and issuing DAEO, processes and tools develop and evaluate alternative JFACC COA and wargame them against JFACC-provided criteria. Once DAEO are executed, the results of those actions are assessed and the results are fed back into the JFC and JFACC planning processes. The scenario ends with the execution and assessment of the JFACC's plan including the TCT and CSAR branches.

Within the COA and branch development parts, the major events occurring in the scenario are presented down to the task level. Next, the specific tasks for each tool participating in the CCP are outlined in sequence. The emphasis here is functional, not technical. Inputs and outputs of each tool are specified. What is scripted and what is live is specified.

Scenario. *Crisis Action Planning Stage I: Situation Development and Stage II: Crisis Assessment*.[17]

Situation: For some time, the US National Command Authority (NCA) has been concerned with reports that Orangeland, a country that traditionally views the US as an adversary, has been taking steps that might provide it with weapons of mass destruction (WMD) and the means to deliver them throughout the region and even potentially threaten the US homeland. While not a formal classification, Orangeland normally is characterized as a "rogue state" in the region and US allies there look to the US for their security. With an increasing amount of tangible evidence of WMD development and the production of ballistic and cruise missiles, the US openly and vigorously protested Orangeland's activities only to be re-buffed with denials. As a precaution, the NCA directed the theater Commander-in-Chief (CINC), US Mediterranean Command (USMEDCOM) to begin planning two contingencies.

The first contingency is military activities, coordinated with diplomatic, information, and potentially economic activities, to deter Orangeland's WMD or theater ballistic missile (TBM) development or deployment activities. The second contingency is military activities to compel Orangeland to stop if they actually deploy or indeed appear to be preparing to employ these weapon systems. The working title for both contingencies is Operation DENY FORCE. These contingencies support on-going, though so far unsuccessful, diplomatic attempts to get Orangeland to the negotiating table.

Input: The NCA issues the following guidance via a *CJCS WARNING ORDER* to CINCMED:

- Find, monitor, and assess state of Orangeland's WMD and TBM development;
- Be prepared to strike surgically to defeat development/deployment;
- Minimize the chances of friendly loss and collateral damage during all operations; and
- Consider non-lethal means along with traditional military means for the strike contingency.
- Normal command relationships apply.

Furthermore, the following forces are made available for planning purposes:

- A Global Strike Task Force (GSTF) comprised of F-22, B-2, Global Hawk and Multi-sensor Constellation Command & Control Aircraft (MC2A).
- An Aerospace Expeditionary Task Force (AETF).
- The *Stennis* Carrier Battle Group (CVBG) and *Wasp* Amphibious Ready Group (ARG).

17 CAP procedures are taken from JP 5-0, *Doctrine for Planning Joint Operations*.

- An Interim Brigade Combat Team (IBCT).
- A Block 30-configured Joint Aerospace Operations Center (JCAOC)

The WARNORD directs the CINC to provide precise requirements upon completion of course-of-action (COA) Development (*Crisis Action Planning Stage III*).

Process: Upon receipt of the WARNORD, the CINC assembles the planning team. While in normal operations this could take one of several forms, for the CCP it is assumed the CINC uses a JFHQ organizational structure and the Unified Command structure for this theater uses Functional Commands. The CCP concentrates on the JFACC (COMMEDAF) and introduces other components only as required. Oftentimes it is the case that the JFC tasks planners to develop Planning Guidance and Commander's Intent as part of the Estimate Process. In the CCP, this step is truncated in order to focus on the JFHQ and its interaction with the component planning staffs (e.g., the Strategy Division within the JCAOC). CINCMED issues the following planning guidance:

- Develop a Flexible Deterrent Option (FDO) that uses ISR assets as a "show of concern" to Orangeland.
- Develop strike COA options, with supporting analysis, that
    - Strike with lethal means only
    - Strike with non-lethal means only
    - Strike with a mix of lethal and non-lethal means [This was included to allow growth in the Common Challenge Problem. It was never elaborated further.]
- Wargame each option with attention to attrition and collateral damage
- Provide Branch plans for each COA option that addresses:
    - TCT: upgraded (e.g., 3rd generation) Orangeland Air Defenses (e.g., SA-10 surface-to-air missiles, SU-37 Flanker aircraft), or any TBM/CM (cruise missile) deployment/employment activities.
    - CSAR

CINCMED also issued the following Commander's Intent:

- End State
    - No WMD/TBM threat to region/US
    - Desired effect: deter deployment of WMD/TBM; on order, disrupt (destroy if ordered) WMD/TBM development/deployment [The Deterrence option was included only for completeness. It was not further elaborated.]

- Purpose: regional stability & US security
- Method: surgical strike
- Risk: low to US forces; medium for collateral damage

For the CCP, a modified planning process is used for *Crisis Action Planning Stage III*. While heavily based upon the one found in Joint Pub (JP) 3-56.1, *Command and Control for Joint Air Operations* and Air Force Doctrine Document (AFDD) 2-1, *Air Warfare*, the key modifications include specifying mechanism between actions (strategy) and results (objectives), and specifying campaign (operational) assessment as separate from, but building upon, combat assessment. This planning process is comports with the one found in JFCOM/J9's JFHQ *Concept of Employment*. Further, within the five JP 3-56.1 Phases, two sub-processes are key. The first is IPB. This four-stage process is based upon JP 2-01.3, *Joint Tactics, Techniques, and Procedures for Joint Intelligence Preparation of the Battlespace* and AFDD 2-5.2, *Intelligence, Surveillance, and Reconnaissance Operations*. This sub-process is expanded upon and re-named Operational Net Assessment (ONA) in the JFHQ *Concept of Employment*. ONA shares JIPB in common with the Air Force's Predictive Battlespace Awareness (PBA) concept. PBA combines IPB (with obvious emphasis on the aerospace aspects of IPB) with ISR planning and management. ONA builds upon IPB (with obvious emphasis on the Joint aspects of IPB) by offering an analysis of what actions might be taken to achieve JFC desired effects.

The second sub-process is a modification of the effects-based planning framework offered by then-Colonel David A. Deptula in *Firing For Effect*. The small change is making explicit the interactive nature of IPB (identifying targets) and effects-based planning (identifying specific effects).

CCP Storyline. *Note: For the early CCP spirals, this part is scripted. Note too the Effects Tasking Order (ETO), seen in Fig. 3-3 in the JFHQ Concept of Employment, is still under development. Except for administrative instructions, it is believed all substantive elements of an ETO is captured in the COA set out below.*

As the planning teams assemble via the JFHQ-directed collaborative network, the planning tasks are broken out through the staff estimate processes. The input is commander's intent. The output is a course-of-action in the form of an ETO. In between, options are generated and wargamed. The results are presented to the JFC for decision. These processes and products are highly interactive between the JFHQ and component planning staffs. The JFACC, for example, would direct preparation of the aerospace estimate of the situation. Within the JFHQ, several teams, cells, boards and agencies are involved. For example, ONA teams start with center-of-gravity (COG) analysis in support of determining Orangeland's PMESII (political, military, economic, social infrastructure, and information) strengths and vulnerabilities. EBO teams begin mission analysis to determine specified, implied, essential and critical tasks in the commander's intent. Logistics teams begin with forces made available for planning to start the detailed time phased force and deployment data processes.

Planners develop strategy options based on three mechanisms. Each is tied directly to the

political-military leadership model of Orangeland. Analysts determined that model showed an autocratic, oligarchic leadership with limited points of access. The first mechanism is destruction, that is, a classic attrition, or brute force, strategy. The defeat mechanism is that by destroying Orangeland's WMD or TBM/CM capabilities, they could no longer threaten their regional neighbors or the US homeland with those systems.[18] The second mechanism is disruption, which is a denial strategy. The defeat mechanism is that by disrupting Orangeland's capability to deploy or employ those systems, it is prevented from threatening others, at least for the moment, and thus, by being denied the means of obtaining their objective (presumed to be regional hegemony) Orangeland would be more likely to negotiate. The final strategy option is coercion through holding these WMD and TBM/CM systems at risk. The defeat mechanism is that the costs of losing these systems outweigh the benefit of having them so that if Orangeland believes the US could indeed destroy these systems (see the first mechanism), then they would more likely negotiate then risk losing these capabilities.

These three options meld into specific COA options by varying the weights, or probabilities, of the three mechanisms. For example, COA option one is heavily weighted towards attriting Orangeland's WMD and TBM/CM capabilities through direct attack on these systems and against a select set of targets within these systems' value chains. Thus, destruction combines with disruption with at least the implicit assumption that, over the course of the campaign, Orangeland will be coerced into negotiation rather than see the continual loss of these valuable—and expensive—systems. These COA options are wargamed against specified criteria. One is the likelihood of US actions provoking Orangeland employment of these capabilities under fear of a "use or lose" scenario. US planners keenly recall charges that Operation ALLIED FORCE in 1999 provoked Yugoslavian leader Slobodon Milosevic to accelerate and intensify the ethic cleansing actions against the Albanian Kosovors. COA option one scores low on this criterion.

Option two, that disrupts Orangeland's WMD and TBM/CM capability not by directly attacking these systems but rather through lethal and non-lethal attacks against supporting systems and infrastructure, scores higher in wargames on this "propensity to provoke" criteria. On the other hand, option two scores lower on three additional criteria. One is time required to accomplish the desired effect. Since Orangeland is best able to determine whether their WMD or TBM/CM capabilities are "disrupted" to such an extent they feel compelled to negotiate, the likelihood is these operations will take longer than under option one. This length is exacerbated by the belief that non-lethal effects take longer to

18 A defeat, or "overcoming," mechanism is normally only specified as such at the national and theater strategic levels (using *Universal Joint Task List* nomenclature). It is defined as the explanation on how the obstacle preventing attainment of a goal is overcome. In a zero-sum situation, it can be viewed as "winning" versus "losing." However, in on-zero sum situations, like a Humanitarian Relief Operations (HUMRO) or deterrence operations where the strategic aim is a negative (such as peace keeping) defeat mechanisms still exist even though terms like winning or losing are not normally used except as propaganda (e.g., "we're winning the peace"). At the theater operational and below levels, it is normally simply referred to as mechanism—the explanation on why the direct or indirect action causes the effect (or outcome).

be felt than effects instigated by direct physical actions. The other two criteria scores derive from the "time-to-complete" criteria. These are "probability of friendly losses" and "probability of collateral damage." The more actions taken, the more likely something goes wrong. These likelihood's are mitigated somewhat by the non-lethal force applications that form part of option two (and three) but not option one.

Option three scores better than the other two on the collateral damage, friendly loss and provocation criteria. It scores worst on time-to-complete and likelihood of attaining the desired effect criteria. That is because it emphasizes non-lethal attacks that demonstrate US capability to harm Orangeland's WMD and TBM/CM capabilities and support systems without actually damaging any. Hence, the success of this option hinges critically on the credibility of the threat. That credibility is a function of resolve to persevere and the willingness to escalate to more lethal means if Orangeland refuses to negotiate.

Across all the criteria, option two scores highest. This is the one recommended to the commander by the planners. The JFC accepts with the caveat that branches are fully fleshed out in regards to two contingencies. The most critical is the provocation scenario. The commander wants ISR assets planned and managed with an eye towards detecting any Orangeland activity that might indicate WMD or TBM/CM deployment or employment. Further, the JFC directs contingency strike planning that can respond quickly to any indications or warnings found by ISR. The second contingency is the loss of an aircraft. Besides the obvious desire to recover any lost pilot, the JFC fears the pilot may become a bargaining advantage Orangeland could exploit to mitigate the US actions.

Output: The COA sent to the components for detailed planning has these elements:

1. What (desired effect): Disrupt (destroy if ordered) Orangeland's WMD and TBM/CM capability to deploy or employ.

2. How (strategy): Attack Orangeland's supporting systems and infrastructure elements, such as Command and Control (C2) or storage, that directly influence their WMD or TBM/CM deployment or employment capabilities.

3. Why (rationale): US desire regional stability and reduced threat to the US homeland. Orangeland WMD and TBM/CM capabilities, and their apparent willingness to use them, threaten both these objectives. Therefore reduction in this threat increases the probability the US attains its objectives.

4. Why (mechanism): If Orangeland's WMD and TBM/CM capabilities are disrupted, then they will more likely negotiate with the US because Orangeland would fear further US action to directly destroy these valuable, and expensive to replace, capabilities.

5. With (resources): Forces made available for planning.

6. Where (location): To be determined by component planners.

7. When (time): Within 24 hours of receipt of EXECUTE ORDER from NCA via CJCS.

8. Who (units): Initial strike by the Global Strike Task Force with follow-on (if required) strike from the CVBG and AETF. ARG and IBCT on call.

9. ROE: take all steps to minimize the likelihood of friendly loss and collateral damage; maximize the use of non-lethal means where appropriate.

With this COA and Commander's Intent, the IPB and EBO toolset develop the JFACC's COA. To separate out scripted IPB from data presented live by various tools, the acronym "Adaptive Sensor Fusion" (ASF) is used to represent live data. The EBO tools are broken out by their specific functionality: strategy development tool (SDT) and campaign assessment tool (CAT). Within SDT, specific functionality is further stated: editor, strategy and mission templates, COG and target system analysis (COG/TSA), and wargaming. In this CCP script, a hook is provided to take task and target data and generate mission data like that found in an air tasking order. The Joint Targeting Toolbox (JTT) is assumed as the source of the Joint Integrated Prioritized Target List (JIPTL), and through its connection with WinJMEM, the source of weaponeering data. A generic "scheduler" is used as a surrogate for a DAEO generator.

Following approval of the COA, JFACC planners develop the mandated branches for TCT and CSAR.

Specific Tasks for Tools (COA development & evaluation)

Source (Blue = EBO; Brown = ASF; Green = scripted)	Action (=> = input/output; P = process)	Destination/Description
Commander's Intent	=>	SDT
	P	Editor: invoke & disaggregate desired effect (end state) from Commander's Intent into specified and implied tasks (surrogate for mission analysis) => Mission templates
	P	Editor: determine desired cumulative effects (conditions) => Strategy templates
	P	COG/TSA: invoke & request data for leadership, telecommunication, IADS, road LOC, and electrical power models
ASF	=>	EOB data to IADS model (this is scripted for Spiral 0)
IPB	=>	Scripted data (Pacifica?) to all other COG/TSA models

	P	COG/TSA: determine objects of effects, complex and indirect effects, mechanisms, and indicator options of those => Strategy & Mission templates; => indicator option to ISR Quilt
	P	ISR Quilt: determine ISR coverage; rack & stack indicator options based upon coverage => Strategy & Mission templates
	P	Strategy & Mission templates: invoke & request data for COA options (attrition, denial and counter arms)
Commander's Intent	=>	Strategy option data (method & purpose) to Strategy templates
Resources	=>	Force data to Mission templates
	P	Strategy & Mission templates: determine direct effects, mechanisms and actions with indicator options of each; => indicator option to ISR Quilt
	P	ISR Quilt: determine ISR coverage; rack & stack indicator options based upon coverage => Strategy & Mission templates
	P	Strategy & Mission templates: determine tasks, events & sequence; assemble COA options => Wargame tool
	P	Wargame: wargame each COA option against ECOA options, in a simulated scenario, and analyze output data from the wargame against user-selected criteria
Commander's Intent	=>	Commander's criteria: completeness, probability of attrition, probability of collateral damage, probability of provoking WMD response, time-to-attaining desired effect
IPB	=>	Enemy COA data: most likely ECOA, most dangerous ECOA (WMD attack)
SDT	=>	COA options to CAT
CAT	P	Assemble Bayes net; assess probability of attaining Commander's Intent

Planner	=>	Probability data
CAT, SDT (Wargame tool)	=>	COA data for decision brief; COA data => to JTT
JTT	P	Develop and weaponeer Joint Integrated Prioritized Target List (JIPTL) => Scheduler
Scheduler	P	Develop time-phased mission data => CAT
CAT	P	Assess probability of attaining Commander's Intent

TCT branch. The first step, as part of the PBA/ONA process, is to characterize the deployment and employment of WMD and TBM/CM systems of Orangeland. From that characterization come the indicators (e.g., "trigger events") that orient RSTA (reconnaissance, surveillance, and target acquisition) assets. This is scripted in the CCP. The focus of this thread in the CCP is on monitoring, tracking and targeting during Execution.[19] The central problems here are maintaining track of a suspected entity throughout its "life cycle" and, secondly, identifying the track. Assuming PBA/ONA can narrow the search in time, space, and attributes, ISR planners can shuffle the "deck" of assets to ensure the right capabilities are in position to find the suspected entities. In this example, the entities of interest are mobile SA-6 and SA-10 surface-to-air missiles (SAM). This is because, in the script, IPB/ONA characterized an early indicator of TBM deployment as relocating SAMs from garrison to positions where they can protect the TBM launchers from air attack. Using a combination of Rivet Joint, Joint STARS, U-2, and Predator UAV, ISR planners establish orbits and sequences to ensure the SAM's detection.

Attack planners determine a SEAD CAP is required, using F-15E assets from the follow-on AETF, to ensure rapid enough response to the SAM's movement. Together with the ISR planners, the attack planners map out precisely the timelines from "find" to "engage." They then identify ISR asset requirements to verify target status after engagement. This is scripted in Spiral 0 but live in Spiral 1. They also identify the decision points where the commander may need to intervene. During the scripted branch wargaming exercise, there is a conflict over Predator priorities between supporting this branch and supporting post-attack BDA collection.

Specific Tasks for Tools (TCT Planning)

Source (Blue = EBO; Brown = ASF; Green	Action (=> = input/output; P =	Destination/Description

19 Conceptually, this is often stated as "plan, find, fix, track, target, engage and assess" or "monitor, assess, plan, and execute" or "observe, orient, decide, and act." Regardless of the sequence used, they all describe a decision-making process.

= scripted)	process)	
IPB	=>	ASF: ECOA model predicts location of SAM
ASF	P	EOB data => SDT Mission Templates (MT)
Wargame	=>	ISR Quilt, SDT, CAT: ISR (Predator) conflicts (target development or BDA collection)
MT	P	Develop SEAD DAEO => CAT, Scheduler
CAT	P	Determine commander decision points
ISR Quilt	P	Determine value-of-information data

Specific Tasks for Tools (TCT Execution)

Source (Blue = EBO; Brown = ASF; Green = scripted)	Action (=> = input/output; P = process)	Destination/Description
ASF	=>	EOB data indicates pop-up SAMs
Combat Operations	P	Execute SEAD DAEO
SDT	P	Determine impact on plan caused by diverting SEAD assets to attack the pop-up SAMs

CSAR branch. Planners treat the second branch as a target-under-trees or a cover, concealment and deception (CCD) problem. CSAR is somewhat different than a TCT problem. The former is more sensitive to location, made worse by CCD efforts, while generally less sensitive to time than a TCT. On the other hand, a TCT is less sensitive to location--within the ellipse of planned weapons such as AGM-130 is generally good enough--but the timing window can be less than 10 minutes from “find” to “engage.” Second, CSAR assets are dedicated assets whereas TCT assets may have to be diverted from other missions. Thus, TCT decisions require more trade-off analysis, under stricter time constraints, than CSAR. The one mitigating factor, of course, is that if all goes as planned, the friendly survivor is an active participant in the rescue attempt whereas in classic CCD, the adversary in taking measures, both active and passive, to thwart

detection. On the other hand, in a CSAR scenario the survivor is trying to thwart the adversary detecting their location. Further, CSAR planners must account for the situation where, for a myriad of reasons, the survivor's electronic apparatus is not working or, perhaps due to physical incapacitation, the survivor is completely passive in their rescue.

DAR (Designated Areas for Recovery) data is generated as part of planning. Also supporting is Enemy Order of Battle (EOB) data so planners understand where the highest threats are likely to be encountered. Obviously, that is where the SEAD assets are concentrated but it is also, where the greatest likelihood of a shoot down occurs.

When the shoot down occurs (that is, CSAR execution), ISR assets are re-configured to support the rescue. Of great importance is the GMTI data that monitors vehicular traffic in and around the survivor's location. This is an input into the decision-making process on how much time is available to prevent the survivor's capture.

Specific Tasks for Tools (CSAR Planning)

Source (Blue = EBO; Brown = ASF; Green = scripted)	Action (=> = input/output; P = process)	Destination/Description
ASF	=>	EOB data to SDT

Specific Tasks for Tools (CSAR Execution)

Source (Blue = EBO; Brown = ASF; Green = scripted)	Action (=> = input/output; P = process)	Destination/Description
ASF	=>	GMTI data to SDT

Closing. The scenario script closes with assessment feeding back into the planning process, which results in further generation of COA options being wargamed then presented to the commander for decision. There are three combat assessment tasks dealing with initial GSTF strikes, the TCT and CSAR missions. The one campaign assessment task takes the result of these three combat assessments and folds them into an assessment on whether the JFC's desired effects are being achieved. As with any plan, the results are mixed. Campaign assessment tells why these results are mixed. Passing that back to planners starts the process of COA refinement through branch and sequel planning.

Specific Tasks for Tools (Assessment)

Source (Blue = EBO; Brown = ASF; Green = scripted)	Action (=> = input/output; P = process)	Destination/Description

JTT	=>	CAT: BDA data
CAT	P	Determine progress towards attaining commander's intent; provide drill down to show where the COA is working as planned and where it is not

Appendix D: ODF Joint Air Operations Plan

REFERENCES: “Pacifica” (“Califon”) data set.

COMMAND RELATIONSHIPS: Per MEDCOM’s SOP, Commander, Mediterranean Air Forces (COMMEDAF), is designated Joint Force Air Component Command (JFACC), Area Air Defense Commander (AADC), and Airspace Control Authority (ACA).

Time Zone used throughout this JAOP: ZULU (Z)

1. (U) Situation: For some time, the US has been concerned with reports that Orangeland, a country that traditionally views the US as an adversary, has been taking steps that might provide it with weapons of mass destruction (WMD) and the means to deliver them throughout the region and even potentially threaten the US homeland. Additionally, Orangeland harbors and promotes terrorist organizations implacably opposed to US values. Some of these groups have exhibited global reach. While not a formal classification, Orangeland normally is characterized as a “rogue state” in the region and US allies there look to the US for their security. With an increasing amount of tangible evidence of WMD development, the production of ballistic and cruise missiles and terrorist activity, the US openly and vigorously protested Orangeland’s activities only to be re-buffed with denials. As a precaution, the Secretary of Defense (SECDEF) directed the theater Commander, US Mediterranean Command (COMUSMEDCOM) to begin developing plans to deter Orangeland from deploying WMD systems or, if deterrence fails, be prepared to disrupt or destroy those systems.

a. (U) COMUSMED issued the following guidance:

1) (U) Protect US forces. This includes deploying and in-theater forces.

a) (U) Coordinate Homeland defense activities with COMUSNORTHCOM and COMUSJFCOM

b) (U) Develop Force Protection plan

c) (U) Develop counter-terrorist strike COA options

2) (U) Develop a Flexible Deterrent Option (FDO) that uses theater-controlled ISR assets as a “show of concern” to Orangeland. Note: this FDO is not part of this JAOP since all events are planned, executed, and assessed by COMUSMED’s Joint Force Headquarters (JFHQ).

3) (U) Develop strike COA options, with supporting analysis, that

a) (U) Strike with lethal means only

b) (U) Strike with non-lethal means only

c) (U) Strike with a mix of lethal and non-lethal means

4) (U) Wargame each option with attention to attrition and collateral damage

5) (U) Provide Branch plans for each COA option that addresses:

a) (U) TCT: upgraded (e.g., 3rd generation) Orangeland Air Defenses (e.g., SA-10 surface-to-air missiles, SU-37 Flanker aircraft), or any TBM/CM deployment/employment activities.

b) (U) CSAR

b. (U) Adversary Forces:

1) (U) Composition, location, disposition, movements, and strengths of major adversary forces that can influence action in the AOR. See EOB overlays. Orangeland has a conventional military of only limited capability. Over the past decade, their emphasis has been on developing weapons of mass destruction and the means of delivering them. The terrorist groups have exhibited global reach and novel means of attacking key, but mainly symbolic, targets.

2) (U) Strategic concept: Orangeland believes their WMD capability provides them advantage over other nations in the region and will deter the US from attacking them. Additionally, Orangeland believes the threat of a direct terrorist attack on the US or its deploying forces will deter US involvement.

3) (U) Major objectives (strategic and operational): Orangeland's strategic objective is to achieve deterrence through assured WMD retaliation against the US or US allies within the region. In the event of hostilities between Orangeland and the US, their operational objective will be to deny US/coalition objectives by denying US access to bases within the region. This could include terrorist attacks against the US homeland and deploying forces. According to USMEDCOM/J2, Orangeland's most dangerous COA arises from their fear of a "use or lose" situation with regard to their WMD or TBM capabilities. In such a case, their operational objective will be US forces and beddown sites within the AOR.

4) Adversary commander's idiosyncrasies and doctrinal patterns. Orangeland's political-military leadership exhibits all the characteristics of an autocratic, oligarchic leadership with limited points of access by either external actors (to include allies, except for Badland) or internal actors.

5) (U) Operational and sustained capabilities. Orangeland has limited ability to project power beyond its borders except for the nascent WMD/TBM capabilities. Associated terror groups do have the capability to project power. It is suspected that Badland is providing at least expertise and perhaps is upgrading Orangeland's military capabilities. According to USMEDCOM/J2, the most likely areas for upgrade include

third-generation Air Defense (AD) capabilities to include aircraft and surface-to-air missiles and the command and control (C2) associated with those systems.

6) (U) Vulnerabilities. Centralized AD C2.

7) (U) Centers of gravity and decisive points.

a) Strategic COGs: Leadership, Military forces, Economy

b) Operational COG: Military Forces (IADS), Infrastructure (road network), Economy (electrical power, POL, telecommunications).

c. (U) Friendly Forces.

1) (U) USARMED: ICBT theater reserve

2) (U) USMARMED: ARG theater reserve to include ACE

d. (U) Assumptions.

1) (U) Badland will not intervene militarily on the side of Orangeland

2) (U) Regional allies will allow access to US forces though access may be restricted as to type of forces (e.g., ISR assets only) that can be based in-country or to overflight only.

2. (U) Mission. When directed, COMMEDAF conducts military operations against Orangeland to deter deployment or employment of Weapons of Mass Destruction against regional allies or the US homeland. If deterrence fails, COMMEDAF will be prepared to disrupt or destroy Orangeland's WMD or delivery capabilities.

3. (U) Air & Space Operations.

a. (U) COMUSMED's Commander's Intent:

1) (U) End State:

a) (U) No WMD/TBM or terrorist threat to region/US

b) (U) Desired effect: deter deployment of WMD/TBM or terrorist attack; on order, disrupt (destroy if ordered) WMD/TBM development/deployment or terrorist infrastructure.

2) (U) Purpose: regional stability & US security

3) (U) Method: surgical strike

4) (U) Risk: low to US forces; medium for collateral damage

b. (U) COMMEDAF's Commander's Intent:

1) (U) End State:

a) (U) Freedom to operate for MEDCOM forces starting with pre-deployment activities through post-deployment

b) (U) No WMD/TBM or terrorist threat to region/US

2) (U) Purpose: regional stability and US security

3) (U) Method: GSTF initial strikes followed by AETF/CVBG persistence forces

4) (U) Risk: low to US forces; medium for collateral damage

c. (U) Operational Concept. If deterrence fails, attack Orangeland's supporting systems and infrastructure elements, such as Command and Control (C2) or storage, which directly influence their WMD or TBM/CM deployment or employment capabilities. Mechanism: *If* Orangeland's WMD and TBM/CM capabilities are disrupted, *then* they will more likely negotiate with the US *because* Orangeland would fear further US action to directly destroy these strategically valuable, and expensive to replace, capabilities.

1) (U) Joint aerospace force organization.

a) (U) Global Strike Task Force: 12 x F/A-22, 6 x B-2, 24 x UCAV, MC2A, RQ-4A (Global Hawk)

b) (U) AETF: 12 x F-15E, 24 x F-16CG, 6 x F-16CJ, 4 x B-1B

c) (U) CVBG: 20 x F/A-18E/F

d) (U) CC-1A JCAOC

2) (U) Joint force aerospace objectives.

a) (U) Gain and maintain air dominance to such a degree to allow unfettered operations by AETF and CVBG follow-on forces.

b) (U) Disrupt (o/o destroy) Orangeland's WMD and TBM/CM supporting infrastructure

3) (U) Beddown overview. See TPFDD.

4) (U) Operational missions. See Phase directives.

5) (U) Phases: Operation DENY FORCE is a two-phased plan. The first phase consists of strikes by GSTF. This phase has two desired effects. One is to deter further deployment of Orangeland's WMD or TBM capabilities. The mechanism is coercion. By demonstrating US resolve and capabilities to hold Orangeland's WMD or TBM assets at risk, Orangeland's leadership could calculate that further resistance to diplomatic negotiation is self-defeating. The

second desired effect for Phase I is to gain air dominance for follow-on attacks by GSTF, AETF and CVBG forces. The mechanism again is coercion. By demonstrating US resolve and ability to strip Orangeland of their air sovereignty, Orangeland leadership is faced with the prospect of further, and potentially wider, air attacks against itself. Phase II has a single desired effect. It is triggered by campaign assessment results that show intransigence on the part of Orangeland leadership and hence failure of the coercion mechanism of Phase I. The desired effect of Phase II is disruption or destruction of Orangeland's WMD and TBM capabilities directly. It consists of strikes that move up the "value chain" of Orangeland's WMD and TBM capabilities ultimately striking at those capabilities directly. This Phase also allows movement from non-lethal to attacks that are more lethal. The mechanism of this Phase is risk. If Orangeland refuses to negotiate the status of their WMD and TBM assets, they will lose them. Underlying both Phases is the need to protect the US homeland and MEDCOM forces. Orangeland is home to numerous terrorist groups and training facilities. Some of these groups have exhibited the ability to strike anywhere on the globe and in novel ways. Such a global threat requires global coordination between all commands.

a) (U) Phase I. Sustained Coercive Airpower

i. (U) Operational concept. This Phase is closely coordinated with diplomatic, economic, and informational instruments of US national power. The diplomatic approach mixes an increasing degree of economic sanctions with promises of economic aid, especially aid to rebuild Orangeland's tottering electrical power grid, with thinly veiled threats of military action. Despite a media relatively closed to outside input, radio, television, and internet means will attempt to relay to the people of Orangeland a sense they are isolated and that their government is on the "wrong side" of international (not US) led efforts to stop the proliferation of WMD. In this context, the GSTF must be prepared to strike within 24 hours of any Orangeland rejection of a US demarche. It is imperative that the rejection-US strike linkage be clearly understood by Orangeland, Badland, and the international community.

ii. (U) General missions and guidance. When directed, GSTF will attack Orangeland with the goal of gaining and maintaining air dominance sufficient for GSTF attack assets to proceed unhindered and to attack designated targets with precision limiting to the maximum extent, collateral damage.

iii. (U) Capabilities/forces required by role or capability. See Phase directive.

iv. (U) Tasks of subordinate commands and components. AETF and CVBG forces are to prepare to move into the AOR to

pre-designated locations with all dispatch and be prepared to conduct sustained attacks against Orangeland.

v. (U) Reserve Forces. N/A

vi. (U) Mobility. As part of the diplomatic-led part of the national strategy, US forces stepped up military-to-military contacts with allies in the region. Ostensibly, to keep a less-threatening profile, these visit consist solely of air refueling assets conducting interoperability training. These assets will establish the air bridge for GSTF and AETF assets. These exercises also allow detailed discussions on Host Nation Support for the AETF in-theater.

vii. (U) IW

1. (U) Deception.

2. (U) Psychological Operations.

b. (U) Phases II. Counterarms.

i. (U) The object of the desired effect in this Phase is the WMD and TBM capabilities of Orangeland. The desired effect is disruption or, if ordered, destruction. The differences between the two are a matter of degree and targeting. Disruption targets individual components of the WMD/TBM target systems without targeting those systems themselves. Furthermore, attacks are planned that limit the degree of damage inflicted on the targets struck. Destructive attacks go after the missiles, TELs, weapons, and closely associated support systems with the intent of eliminating them as viable systems. For both effects, the overall mechanism is the same: Orangeland leadership learns the US has the resolve and capability to eliminate, at will, the systems upon which Orangeland relies to achieve their goal of regional hegemony. There is increased risk in this Phase. By attacking directly Orangeland's WMD/TBM capabilities, they may feel themselves forced into a "use or lose" situation. Hence as part of this Phase, ISR assets must be attuned to, and pointed towards, indicators that might tip off any attempt by Orangeland to employ these systems.

ii. (U) General missions and guidance. When directed, all JFACC assigned and attached forces will attack Orangeland to gain and maintain air dominance such that follow-on forces are unhindered in their attacks against designated targets.

iii. (U) Capabilities/forces required by role or capability. See Phase directive.

iv. (U) Tasks of subordinate commands or components. With the CVBG in place and operationally, JFMCC will assume duties as Regional Air Defense Commander for its sector. COMMEDAF retains AADC and ACA duties.

v. (U) Reserve forces. N/A

vi. (U) Mobility. See Phase I

vii. (U) IW

1. (U) Deception.

2. (U) Psychological Operations.

c. (U) Coordinating Instructions. Per USMEDCOM SOP

4. (U) Administration and Logistics Administrative and logistics support for forces is a service responsibility. COMUSMEDCOM will exercise overall directive authority and will assign directive authority for common support to component commanders, as required. Priority for forward movement will be given to the movement of combat forces.

a. (U) Airlift movement priority: 1B2

b. (U) Strategic lift: Allocation of strategic lift resources as per initial planning subject to further refinement in planning, alert, deployment and execute orders.

c. (U) General. For planning, selective mobilization will be authorized upon declaration of C-Day in support of this operation. Airlift planning will be based on USTRANSCOM with CRAF 1 activated. Sealift planning will be based on USTRANSCOM - controlled fleet plus the RRF and selective requisitioning of U S merchant marine over and above the PRF.

d. (U) Airlift: USMEDCOM will to continue to plan on joint planning document.

e. (U) Sealift: USMEDCOM has been directed to continue to plan on using assets apportioned by planning document, in the appropriate tables under patrol mobilization conditions, to include USTRANSCOM and assets from the RRF and SRF.

f. (U) The JTB has determined that minimum of 30 percent of total air and sealift capability must be allocated to support requirements in other theaters and maintain essential LOC's. USCINCMED may plan on all remaining capability. USCINCTRANS and appropriate supporting commanders, in coordination with USMEDCOM, will apply the appropriate aircraft and ship types and configurations needed to meet cargo and PAX movement requirements. If JTB must address allocations by type (e.g., C-5 aircraft or RO/RO ships), include all necessary data and rational to support JTB action in time for alert order.

g. (U) Load planning factors: Use joint planning document with direct liaison

authorized between ALCON if specific questions arise.

h. (U) Funding: Funding for transportation costs will not be provided by the Joint staff. Parent services(s) of deploying units(s) must provide fund cites for movements. Services will provide funding guidance to USMEDCOM in anticipation of deployment and execute order(s). If the supported combatant commander or providing organizations require intratheater lift support before execute and deployment orders, the parent service(s) of units being supported will fund USMEDCOM tariff charges as applicable.

i. (U) Classification guidance: This JAOP is unclassified in its entirety.

j. (U) Public affairs guidance: Public release of information concerning this operation is not authorized. Public and news media queries should be accepted an referred to OASD (PA) by separate communications.

k. (U) Combat camera: Combat camera will document this operation to maximum extent possible. Neither security classification, OPSEC, nor subject sensitivity will preclude combat camera documentation. Expedite the delivery through the ARFCOS or other appropriate transportation means commensurate with security classification of the imagery.

l. (U) Communications guidance: Where critical communications resources are not satisfied by augmenting or supporting units, COMUSMED will validate and forward requirements for CJCS - controlled mobile an transportable communications equipment in accordance with CJCS MOP3. Because of limited satellite capacity, COMUSMED will recommend relative priorities and allocate channels and circuits within the scope of this crisis.

5.Command, Control, and Communications.

a. (U) Command and Control Relationship:

1) (U) COMUSMEDCOM is the supported combatant commander. COMUSJFCOM, COMUSTRANSCOM, COMUSSTRATCOM, COMUSSOC, and COMUSNORTHCOM are supporting combatant commanders. Department of State, Department of Transportation, CIA, DIA, NSA, DISA, DSAA, DMA, and military services are supporting organizations and agencies.

2) COMARMED, COMNAVMED, COMMEDAF, COMMARMED, and COMSOCMED, are COMUSMEDCOM's active Component Commanders for Army, Navy, Air Force, Marine, and Special Forces respectively. COMUSMEDCOM component commanders are responsible for the deployment of assigned forces and their logistical support.

3) (U) COMUSMEDCOM exercises COCOM authority over all assigned U.S. forces and general direction over U.S. forces operation in the AOR. Command relationships for multinational supporting forces will be

established by agreements between those nations and the U.S. as those forces are made available.

4) (U) COMUSMEDCOM establishes the following subordinate commands:

a. (U) COMARMED is designated as the Joint Force Land Component Commander (JFLCC) and exercises OPCON over all assigned U.S. Army forces, and TACON of designated U.S., allied, and host nation forces.

b. (U) COMNAVMED is designated as the Joint Force Maritime Component Commander (JFMCC).

c. (U) COMMEDAF is designated as the Joint Force Air Component Commander (JFACC), Airspace Control Authority (ACA), Area Air Defense Commander (AADC), and the Search and Rescue Mission Coordinator (SMC).

d. (U) COMSOCMED is designated as the Joint Force Special Operations Component Commander (JFSOCC).

e. (U) COMJPOTF is designated as the Joint Forces Psychological Operations Component Commander (JFPOCC).

5) (U) Command Posts:

a. (U) COMUSMEDCOM will initially be located TBD

b. (U) JFLCC location TBD

c. (U) JFMCC location TBD

d. (U) JFACC location TBD

e. (U) JFSOCC location TBD

f. (U) JFPOCC location TBD

6) (U) Succession to Command: Deputy Commander followed by the senior component commander until appointment of new commander.

7) (U) Signal:

a. (U) Communications employed per USMEDCOM SOP.

b. (U) Use United States Message Text Format (USMTF) procedures to automate messages traffic for all service components. Procedures for reduction of exercise message traffic should be rigidly enforced.

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